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## SOME RESULTS OF THE BRITISH ANTARCTIC EXPEDITION, 1907–9.*

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The British Antarctic Expedition, 1907–9, left Port Lyttelton, New Zealand, on January 1, 1908, for the south. In this article I will not attempt to deal in detail with the preliminary arrangements and with the equipment. The amount of money at my disposal had been limited, and economies had been necessary in various directions; but I had been able to get together a small body of well-qualified men, and we were fully equipped as far as food, clothing, sledges, etc., were concerned. We had a motor-car, ponies, and dogs for haulage purposes. The generosity of the Admiralty in lending the expedition a number of instruments enabled me to make the scientific equipment fairly complete. The *Nimrod*, in which the journey to the winter quarters on the Antarctic continent had to be undertaken, was certainly small for the work, and left Lyttelton with scarcely 3 feet of freeboard, a somewhat serious matter in view of the fact that very heavy weather had to be faced. On the other hand, the ship was very sturdy, well suited to endure rough treatment in the ice.

The shore party consisted of fifteen men, my companions being as follows:—

Lieut. J. B. Adams, R.N.R., meteorologist.
Bertram Armytage, in charge of ponies.
Sir Philip Brocklehurst, assistant geologist.
Prof. T. W. Edgeworth David, F.R.S., geologist.
Bernard Day, electrician and motor expert.

* Maps, p. 592.

Ernest Joyce, in charge of general stores, dogs, sledges, and zoological collections.
Dr. A. F. Mackay, surgeon.
Dr. Eric Marshall, surgeon, cartographer.
G. E. Marston, artist.
Douglas Mawson, mineralogist and petrologist.
James Murray, biologist.
Raymond Priestley, geologist.
William Roberts, cook.
Frank Wild, in charge of provisions.

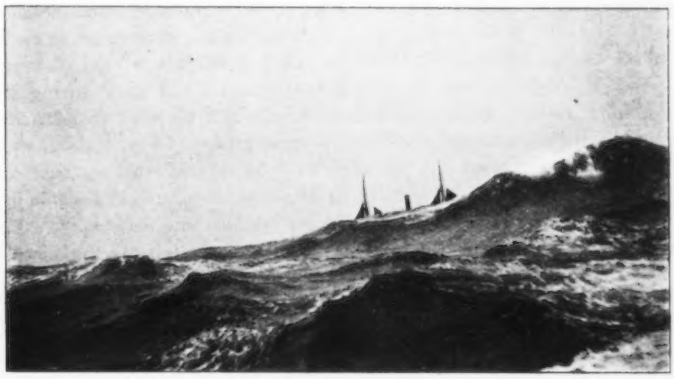
Prof. David, of Sydney University, joined the expedition at the last moment, and the services of such an experienced scientific man were invaluable. Douglas Mawson was lecturer in mineralogy and petrology at the Adelaide University. James Murray had been biologist on the Scottish Lake Survey, and had made a special study of microscopic zoology, a circumstance that led to most important discoveries in the frozen lakes of Ross island. Joyce and Wild, like myself, had served on the National Antarctic Expedition.

My original intention was to winter on King Edward VII. Land, a part of the Antarctic continent at present quite unknown. The *Nimrod* was towed to the Antarctic circle, a distance of 1500 miles, in order that her small supply of coal might be conserved, and we were soon in the belt of ice that guards the approach to the Ross sea. The navigation of the ice was not more than usually difficult, and on January 16 we entered the Ross sea in 178° 58′ E. long. (approximate). Keeping a south-westerly course, we sighted the Great Ice Barrier on January 23, and proceeded to skirt the ice-edge in an easterly direction towards Barrier inlet (Balloon bight), the spot selected by me as the site for the winter quarters. I knew that the inlet was practically the beginning of King Edward VII. Land, and that it would be an easy matter for the ship, in the following summer, to reach us there, whereas the land sighted by the *Discovery* Expedition might be unattainable if the season were adverse. In 165° E. long., near the point where Borchgrevink landed in 1900, we sighted, beyond 6 or 7 miles of flat ice, steep-rounded cliffs, having the appearance of ice-covered land. We could not stop to investigate.

The plan proved impracticable, for we found that Barrier inlet had disappeared. Many miles of the Barrier edge had calved away, and instead of the narrow bight there was a wide bay joining up with Borchgrevink's inlet, and forming a depression that we called the Bay of Whales. We accordingly made an attempt to reach King Edward VII. Land, but here again we were unsuccessful. The way was barred by heavy consolidated pack, into which bergs were frozen, and this ice stretched far to the north. The season was advancing; the *Nimrod* was leaking, as a result of severe gales on the journey south, and I decided

that we had better proceed direct to McMurdo sound, and establish the winter quarters there. The *Nimrod* entered the sound on January 29, and was brought up by fast ice 20 miles from Hut point, the spot at which the *Discovery* Expedition wintered in 1902 and 1903. The ice showed no signs of breaking out, and on February 3 we proceeded to land stores, and erect a hut on Cape Royds, the spot selected, under pressure of circumstances, for the winter quarters of the expedition. On February 22 the *Nimrod* went north again, leaving the shore-party at Cape Royds. The ship was to return in the following summer.

The first work of importance undertaken after the winter quarters had been established was the ascent of Mount Erebus. This active volcano, which has an altitude of over 13,000 feet, was of particular interest from the geological and meteorological standpoint, and though the ascent was likely to prove difficult, it seemed that the attempt



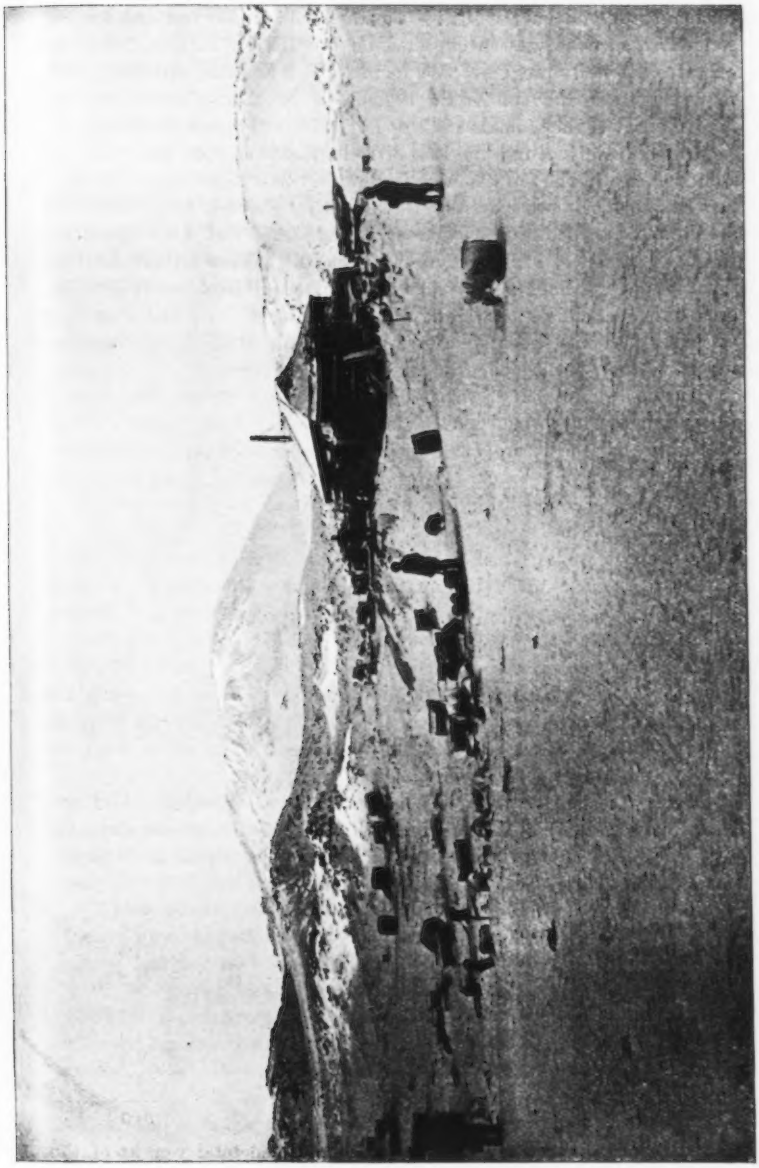
*KOONYA* TOWING *NIMROD*.

should be made. A party of six set out from the winter quarters on March 5, and on the morning of March 10 five of the men stood on the edge of the active crater, the sixth having been left at the last camp with frostbitten feet. The scientific results of the journey were both interesting and important. The party found that the height of the active crater is 13,350 feet above sea-level, the figures being calculated from aneroid levels and hypsometer readings, in conjunction with simultaneous readings of the barometer at the winter quarters. It was noted that the moraines left at the period of greater glaciation ascend the western slopes of Mount Erebus to a height of fully 1000 feet above sea-level. As the adjacent portion of McMurdo sound is at least 1800 feet deep, the ice-sheet at its maximum development must have had a thickness of not less than 2800 feet. Two distinctive features of the geological structure of Mount Erebus were the ice-fumaroles, and the vast

quantities of large and perfect felspar crystals. Unique ice-mounds have been formed in the cup of the second crater, from which rises the present active cone, by the condensation of vapour round the orifices of fumaroles. Only under conditions of extremely low temperature could such structures come into existence. The felspar crystals, found in enormous quantities mixed with snow and fragments of pumice in the second crater, were from 2 to 3 inches in length, and very many were perfect in form. The fluid lava which had surrounded them had been blown away by the force of the explosions which had ejected them from the crater. The valuable meteorological observations made cannot be stated within the scope of this article.

The most important event of the winter months was the discovery by the biologist of microscopical life in the frozen lakes of the Cape Royds district. Investigations showed that algæ grew at the bottom of the lakes, which are frozen during the greater part of the year, and in some cases thaw completely only in exceptionally warm seasons. The microscope showed that rotifers, water-bears, and other forms of minute animal-life existed on the weed. A shaft was sunk through 15 feet of ice to the bottom of a lake which did not thaw during the two summers that we spent at Cape Royds, and on weed found under the ice there were living rotifers of several kinds. Other rotifers were found on weed melted out of solid ice. It seemed obvious that the microscopic animals were able to live at a temperature at least as low as 40° below zero Fahr., and experiments verified this conclusion. The animals were not killed by that temperature, though all the natural functions were suspended, including the bearing of young among the viviparous species. They were alternately frozen and thawed weekly for a long period, and took no harm. They were dried and frozen, thawed and moistened, and still they lived. They lived in brine so salt that it froze only at a temperature of about zero Fahr., and many of them survived the test of being dried and placed in a bottle, which was then immersed in boiling water. Some of the weed carrying the animals was dried and conveyed to London, being subjected to tropical temperatures on the way. It was moistened in London, and the animals were found to be still living. They survived a final test of immersion in frozen gas at a temperature of −81° C. The whole subject is one of extraordinary interest to biologists, and the scientific memoirs of the expedition will embody the results of all Murray's observations and experiments.

Early in the spring of 1908 we began to make arrangements for the sledging journeys. One party, led by myself, was to go south towards the geographical pole; Prof. David was to take a second party north, and attempt to attain the south magnetic pole; and a third party was to undertake geological work in the mountains west of McMurdo sound, with the special object of discovering fossils. The motor-car had not



WINTER QUARTERS, CAPE ROYDS.

proved a success. The petrol engine ran well, even at low minus temperatures, and on the sea-ice the car could travel fast and far, but soft snow, such as was encountered on the Barrier surface, formed an effective bar to its progress. We had left New Zealand with ten ponies, imported from the sub-Arctic regions of Northern Manchuria, and landed eight of the animals at Cape Royds in fairly good condition.

Unfortunately, four were lost early in the winter, so that only four were left available for the sledging work. We had dogs, bred from the Eskimo dogs used by the Newnes-Borchgrevink Expedition, but after the experience of the *Discovery* Expedition I had little confidence in these animals. I pinned my faith on the ponies for the southern journey. Experiments showed that they could haul easily 650 lbs. each, this including the weight of the sledge (60 lbs.), and that they travelled well on bad surfaces, thus realizing the hopes I had based on reports of their performances in their native country.

I made a preliminary journey on to the Barrier before the return of the sun, taking with me Prof. David and Armytage, in order to get an idea of the surface to be encountered. We experienced very low temperature, below −57° Fahr., and we only stayed out for a few days. By means of a series of sledging journeys from Cape Royds, we established a depôt of stores at Hut point, and on September 22 a party started out to lay a depôt on the Barrier beyond Minna bluff in readiness for the southern journey. The temperature got down to −59 Fahr., with blizzard winds, and the petroleum for the cookers was practically frozen at times, while off Minna bluff we got amongst crevasses.

On October 6 we laid the depôt in lat. 79° 36′ S., long. 168° E., a distance of 120 miles from the winter quarters. We reached the hut again on October 13. In the mean time, Prof. David, Douglas Mawson, and Dr. Mackay had started on their journey to the south magnetic pole. I did not see them again until March 1, 1909.

The southern party was to consist of Adams, Marshall, Wild, and myself. I decided to take provisions and oil for ninety-one days, the daily allowance of food, as long as full rations were given, to be 34 ozs. The allowance was made up as follows:—

| | ozs. |
|---|---|
| Pemmican | 7·5 |
| Emergency ration | 1·5 |
| Biscuit | 16·0 |
| Cheese or chocolate | 2·0 |
| Cocoa | 0·7 |
| Plasmon | 1·0 |
| Sugar | 4·3 |
| Quaker oats | 1·0 |
| | 34·0 |

Tea, salt, and pepper were used in addition. The total weight of the provisions taken was 773 lbs. 8 ozs. Each pony was to draw an 11-foot

sledge. In regard to our own clothing, we made a radical reduction in weight as compared with previous expeditions. We wore Burberry windproof gaberdine over Jaeger woollen undergarments, and used furs only for the hands and feet and for the sleeping-bags. I am satisfied that we could not have travelled as far as we did in the time at our disposal had we worn the usual heavy garments. The other articles of our equipment were along the lines laid down by other polar explorers, weight having been reduced to the minimum in each case. The scientific equipment included a 3-inch theodolite with stand, three chronometer watches, three pocket compasses, one hypsometer, eight thermometers, one case surveying instruments, two prismatic compasses, one sextant with artificial horizon, and camera with plates. The food

*NIMROD* OFF CAPE ROYDS.

for the ponies consisted of maize and Maujee ration, with a little Australian compressed fodder, 900 lbs. in all, the allowance for each pony being 10 lbs. per day.

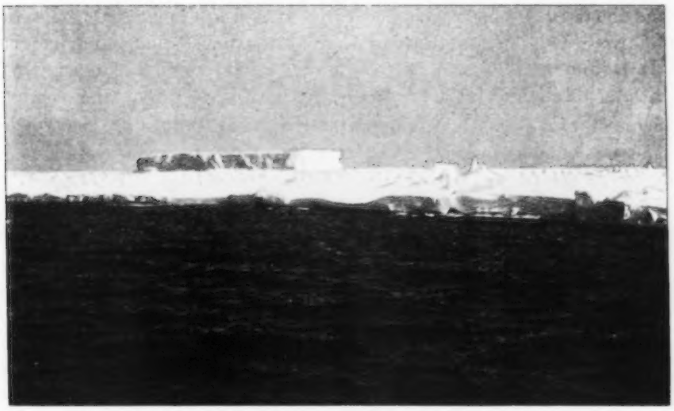
The southern party left the winter quarters on October 29, accompanied by a supporting party of six men. Progress at first was slow, heavy weather and crevassed ice being encountered; and it was not until November 15 that we reached the depôt laid out on the spring journey, the supporting party having left us some days previously. The ponies were pulling well, and I was feeling very satisfied with the change from the dogs used when I accompanied Captain Scott on his southern journey in 1902. The surface was soft, but we were able to move south at the rate of about 15 miles each day. Our course lay further from the land than the course followed by the previous expedition, as is shown on the accompanying chart. Good marches were

made in the days that followed, and on November 26 we camped in lat. 82° 18½′ S., long. 168° E., having passed the "furthest south" record. New land had come within our range of vision by this time, owing to the fact that we were far out from the base of the mountains, and I had noted with some anxiety that the coast trended south-south-east, thus threatening to cross our path and obstruct the way to the pole. We could see great snow-clad mountains rising beyond Mount Longstaff, and also far inland to the north of Mount Markham. On November 26 we opened out Shackleton inlet, and looking up it sighted a great chain of mountains, while to the west of Cape Wilson appeared another chain of sharp peaks, about 10,000 feet high, stretching away to the north beyond Snow cape, and continuing the land on which Mount A. Markham lies. The first pony had been killed on November 21, when we were south of the 81st parallel, and we had left a depôt of pony-meat and ordinary stores, to provide for the return march. We started at once to use pony-meat as part of the daily ration, and soon found that scraps of raw, frozen meat were of assistance on the march in maintaining our strength and cooling our parched throats. A second pony was shot on November 28, and a third on December 1, by which time we were closing in on the land, and it had become apparent that we would have to find a way over the mountains if we were to continue the southern march. We were still sighting new land ahead, and the coast-line had a more distinct easterly trend. We camped on December 2 in lat. 83° 28′ S., long. 171° 30′ E., opposite a red granite mountain about 3000 feet in height. On the following day we climbed this mountain, and from its summit saw an enormous glacier, stretching almost due south, flanked by huge mountains, and issuing on to the Barrier south of our camp. We decided at once that we had better ascend the glacier, and on the following day made our way, with two sledges and the last pony, on to its surface.

We encountered difficulties at once, for the snow-slopes by means of which we gained the glacier surface gave way to blue ice, with numberless cracks and crevasses, many of them razor-edged. Travelling on this surface in finesko was slow and painful work. On December 5 Marshall and Adams, who were ahead looking for a route, reported that at a point close to the granite cliffs, a bird, brown in colour, with a white line under each wing, had flown over their heads. They were sure it was not a skua gull, the only bird likely to have been attracted by the last dead pony. It was a curious incident to occur in lat. 83° 40′ S. We left the fourth depôt close to the foot of the glacier, at the foot of a wonderful granite cliff, polished by the winds and snows of ages. On December 6 we took six hours to pass about 600 yards of severely crevassed ice, over which all our gear had to be relayed, and on the following day we lost the last pony, which fell into a crevasse disguised, like so many others, by a treacherous snow-lid.

Wild was leading the pony with one sledge, while Adams, Marshall, and myself went on ahead with the other sledge and pioneered a practical path. We had passed over a snow-covered crevasse without noticing it, but the greater weight of the pony broke through the lid, and the animal dropped through, probably to a depth of several hundreds of feet. Happily the swingle-tree snapped with a sudden strain, and Wild and the sledge were saved. This accident left us with two sledges and a weight of about 250 lbs. per man to haul. Our altitude at this time was about 1700 feet above sea-level.

During the days that followed we made steady progress up the glacier, experiencing constant difficulty with the crevasses. We hauled well ahead of the sledges, so that when one of us dropped through a snow-lid the harness would support him until he could be hauled up



HEAVY PACK-ICE.

again. We had many painful falls as a result of having no footgear suitable for the ice-climbing, and any future travellers would do well to take boots with spikes. A special form would have to be devised, on account of the low temperature rendering impracticable the use of ordinary mountaineering boots. New land appeared day after day, and we were able to make small geological collections and to take some photographs. The rocks were sedimentary, the lines of stratification often showing clearly on the mountain-sides, and we made two geological discoveries of the first importance. In lat. 15° S., Wild, who had climbed the slope of a mountain in order to look ahead, found coal, six seams ranging from 4 inches to 7 or 8 feet in thickness, with sandstone intervening. Close to this point I found a piece of sandstone showing an impression, and microscopic investigation has shown that this was fossil coniferous wood.

The glacier proved to be about 130 miles in length, rising to an altitude of over 9000 feet. Christmas Day, 1908, found us in lat. 85° 55′ S., a plateau with icefalls appearing to the south. Much glaciated land trended to the south-east, apparently ending in a high mountain shaped like a keep. The land to the west had been left behind. It was evident that we were still below the plateau-level, and, though we were getting free of the crevasses, we were hindered by much soft snow. The level was rising in a series of steep ridges about 7 miles apart. We had started to reduce rations before leaving the Barrier surface, and by Christmas Day were marching on very short commons. Our temperature was 2° sub-normal, but otherwise we were well and fit.

On December 31 we camped in lat. 86° 54′ S. We had not yet reached the plateau-level, for slopes still lay ahead, and our altitude was about 10,000 feet. We had three weeks' food on a reduced ration, and were 186 geographical miles from the pole. The land had been left behind, and we were travelling over a white expanse of snow, still with rising slopes ahead. We were weakening from the combined effects of short food, low temperature, high altitude, and heavy work. We were able to march on the first six days of January, and on the night of January 6 camped in lat. 88° 7′ S. We had increased the daily ration, for it had become evident that vitality could not be maintained on the amount of food we had been taking. I had been forced to abandon the hope of reaching the pole, and we were concentrating our efforts on getting within 100 miles of the goal.

A fierce blizzard blew on January 7 and 8, and made any march impossible. We lay in our sleeping-bags, frequently attacked by frost-bite. The wind ceased at 1 a.m. on January 9, and at 4 a.m. we started south, leaving the camp standing, and taking only instruments, food, and the flag. At 9 a.m., after five hours' marching over a fairly hard surface, we calculated we were in lat. 88° 23′ S., and we hoisted the flag. The snow plain stretched southward to the horizon without a break.

The homeward march was rendered difficult by shortage of food and attacks of dysentery, due to the meat from one of the ponies. We picked up a depôt left on the plateau on January 4, and made rapid progress to the north. The blizzard winds from the south, which had hampered us on the outward journey, now proved of assistance, for we made a sail from the floorcloth of a tent, and travelled fast with our one remaining sledge. On January 19 we covered a distance of 29 miles down the glacier. On January 16 we ran out of food when 16 miles from the glacier depôt, and we marched for thirty-one hours with only a little tea and chocolate. We were able to reach the depôt in an exhausted condition. We left the glacier and reached the Barrier surface on January 28, but Wild was attacked by dysentery, and a little

later we all suffered. The trouble was evidently due to the meat from one pony, and as the frozen flesh could not have become tainted in the usual way, we assumed that it was due to the toxin of exhaustion, the animal having been killed when very weary.

We were assisted on the southward march over the Barrier by snow mounds erected on the outward journey, and we picked up the depôts without any difficulty, reaching each with our food-bags empty. We could not march at all on February 4, owing to acute dysentery, but we

THE TOP OF EREBUS.

were able to continue on the following days, and on February 23 we reached a depôt laid out off Minnu bluff in readiness for our return by a party from the winter quarters. We were all safe on board the *Nimrod* on March 4.

The latitude observations made on the southern journey were taken with the theodolite, as were all the bearings, angles, and azimuths. Variation was ascertained by means of a compass attached to the theodolite, and the steering compasses were checked accordingly. At

noon each day the prismatic compasses were placed in the true meridian, and checked against the theodolite compass and the steering compasses. The last latitude observation on the outward journey was taken in 87° 22′ S. and the remainder of the distance towards the south was calculated by sledge meter and dead reckoning. The accuracy of the sledge meter had been proved by the fact that the daily record of distance travelled agreed roughly with the observations for position. We took only one observation on the return journey, on January 31, and then found that our position had been accurately recorded by the sledge meter.

The results of the southern journey may be summarized briefly. We found that a chain of great mountains stretched north by east from Mount Markham as far as the 86th parallel, and that other ranges ran towards the south-west, south, and south-east between the 84th and the 86th parallels. We ascended one of the largest glaciers in the world on to a high plateau, which in all probability is a continuation of the Victoria Land plateau. The geographical pole almost certainly lies on this plateau, at an altitude of between 10,000 and 11,000 feet above sea-level. The discovery of coal and fossil wood has a very important bearing on the question of the past geological history of the Antarctic continent.

The Northern Party consisted of Prof. David, Dr. Mackay, and Douglas Mawson. The three men left Cape Royds on October 5, and travelled on the sea-ice along the coast as far as the Drygalski Barrier tongue. They had neither dogs nor ponies, and as they could not haul the whole of their load at one time they had to relay their two sledges, thus covering the ground three times. They reached the Drygalski tongue on November 30, and from that point struck inland in a north-west direction, with a lightened load, towards the south magnetic pole. They crossed the Drygalski glacier with very great difficulty, a fortnight being occupied in gaining 20 miles over steep ice ridges and crevasses, and twice failed in attempts to climb on to the inland plateau, first by means of the Mount Nansen glacier and then up the Bellingshausen glacier. Finally, they succeeded in finding a path up a small tributary glacier to the south of Mount Larsen and gained the plateau. Then came a painful march over the plateau, which gradually rose to an altitude of over 7000 feet, in the face of blizzards, broad undulations, and high sastrugi. On January 16, 1909, the party reached lat. 72° 25′ S., long. 155° 16′ E., the approximate position of the magnetic pole as calculated from the observations taken by Mawson with the Lloyd-Creak dip circle. The journey back to the coast had to be made by forced marches, for the party knew that the sea-ice would have broken out and that their hope of safety depended largely on the *Nimrod*, which was to cruise along the coast as far as Cape Washington early in January. They reached the Drygalski Barrier tongue on January 3,

and on the following morning, by a happy combination of circumstances, were picked up by the ship, which was on its way back to the winter quarters, after a fruitless search along the coast. The party did very useful geographical work in the course of its journey, for Mawson triangulated the coast of Victoria Land from McMurdo sound to the Drygalski barrier, and many new peaks, glaciers, and tongues were discovered, as well as two small islands. Prof. David studied the geological conditions with good results.

CURIOUS ICE FORMATION.

The Western party consisted of Armytage, Priestley, and Brocklehurst, and it first proceeded up the Ferrar glacier as far as the Solitary rocks, with the special object of searching for fossils in the Beacon sandstone formations. Priestley made a thorough geological search of the neighbourhood, but without success, so far as fossils were concerned. The party descended the glacier with the object of joining the Northern party, according to my instructions, but the junction was not effected, owing to the delays that had overtaken Prof. David and his companions.

Priestley was able to work at the Stranded Moraines and in Dry valley. The party was picked up by the *Nimrod* on January 25, after narrowly escaping disaster on a drifting icefloe.

All the members of the expedition were aboard the *Nimrod* on March 4, 1909, and we proceeded north under steam at once, for the season was advancing, and the sea-ice had commenced to form. We were off Cape Adare on March 6, and I made an attempt to push on west of Cape North, with the object of securing knowledge of the coast-line. The pack-ice, which was thickening rapidly, and threatened to prison the ship, prevented the *Nimrod* going as far as I had hoped, but we got to long. 166° 14′ E., lat. 69° 47′ S., and on the morning of March 8, from that position, we saw a new coast-line stretching first to the southwards, and then to the west for a distance of over 45 miles. We took angles and bearings, and sketched the outline. Then we went north, and on March 22 reached New Zealand.

The geological work of the expedition was carried on by Prof. T. W. Edgeworth David and Raymond Priestley. I have already mentioned matters connected with the Great Ice Barrier. Their conclusions in regard to other points are summarized as follows:—

(1) Throughout the whole of the region of Antarctica examined by us for 16° of latitude there is evidence of a recent great diminution in the glaciation. In McMurdo sound this arm of the sea, now free from land ice, was formerly filled by a branch of the Great Ice Barrier, whose surface rose fully 1000 feet above sea-level, and the Barrier ice in this sound, in areas from which the ice has retreated, was formerly about 3000 feet in thickness.

(2) The snowfall at Cape Royds from February, 1908, to February, 1909, was equal to about 9½ inches of rain.

(3) The *névé*-fields of Antarctica are probably of no great thickness.

(4) The southern and western sides of the sector of Antarctica south of Australia is a plateau from 7000 to 10,000 feet high, which may possibly extend across the south pole to Coats' Land and Graham's Land.

(5) Ross sea is probably a great subsidence area.

(6) The Beacon sandstone formation, which extends for at least 1100 miles from north to south in Antarctica, contains coniferous wood associated with coal-seams. It is probably of Palæozoic age.

(7) Limestones, pisolitic in places, in 85° 25′ S., and 7000 feet above sea-level, contain obscure casts of radiolaria.

Radiolaria, in a fair state of preservation, occur in black cherts amongst the erratics at Cape Royds. They appear to belong to the same formation as the limestone. These radiolaria appear to be of older Palæozoic age.

(8) The succession of lavas at Erebus appears to have been first trachytes, then kenytes, then olivine basalts. Erebus is, however, still erupting kenyte.

(9) Peat deposits, formed of fungus, are now forming on the bottoms of some of the Antarctic glacial lakes near 77° and 78° S.

(10) Raised benches of recent origin extend at Ross island to a height of at least 160 feet above sea-level.

CAMP, SOUTHERN JOURNEY.

CAMP ON SOUTHERN JOURNEY.

The fossil in Beacon sandstone found by the southern party in lat. 85° S. is described as follows by Mr. E. J. Goddard, B.SC., Macleay Research Fellow of the Linnæan Society, New South Wales:—

"Longitudinal sections of the included dark masses give a homogeneous banded appearance of a distinctly organic nature. The banded appearance is due to the vascular nature of the organic elements composing the mass. The whole structure recalls to one's mind the appearance given by longitudinal sections of the xylem portion of the vascular area of a gymnosperm, such as *Pinus*. Only the xylem area is represented in the specimen, no traces of medullary, cortical, or phloem tissue being visible. Medullary rays are present, as shown in the micro-photograph.

"The xylem itself is composed of a homogeneous mass of vessels, tracheidal in nature, no differentiation as regards the vascular elements being present. In places one may readily make out in longitudinal sections dark opaque bands of much greater size individually than the tracheides. These, in all probability, represent resin passages belonging to the xylem. It would seem, further, that these masses might be considered as being nothing more than an aggregation of material similar in nature to that of the walls, and due to changes under the process of petrifaction. This, however, is opposed by the fact that they occur even in these small sections fairly commonly and at the same time are all of exactly the same size as regards width. At all events, they represent some definite structure, and in all probability resin passages.

"The walls of the tracheids themselves, seen under the high power of the microscope, appear to be pitted; but the preservation is by no means good enough to warrant any remarks on this, beyond that in the common wall of adjacent tracheides occur clear spaces of the same relative importance as the bordered pits of such a gymnosperm as *Pinus*. These clear spaces occur regularly along the length of the tracheides, and stand out strongly against the dark colour of the walls in their preserved condition.

"The nature of the xylem itself leads to the conclusion that it is a portion of a gymnospermous plant, resembling strongly in nature the same portion of a coniferous plant."

The meteorological observations taken during our stay in the Antarctic have yet to be studied, and only tentative conclusions have, so far, been reached. Systematic observations were taken during the voyages of the *Nimrod* between New Zealand and MacMurdo sound, and at Cape Royds observations were recorded at intervals of two hours from March, 1908, to February, 1909. During this period no rain fell. The lowest temperature definitely recorded was $-57°$ Fahr. near White island on the Great Ice Barrier on August 14, 1908. We were able to secure interesting observations of the upper currents of the air at Ross island. Reporting on this subject, Prof. David and Lieut. Adams state—

"At Mount Erebus our winter quarters were situated in an

exceptionally favoured position for observing the upper currents of the atmosphere. Not only had we the great cone of Erebus to serve as

VIEW OF LAND WHERE COAL WAS FOUND.

SOUTHERN PARTY AFTER THEIR RETURN.

a graduated scale against which we could read off the heights of the various air-currents as portrayed by the movements of the clouds

belonging to them, but we also had the magnificent steam column in the mountain itself, which, by its swaying from side to side, indicated exactly the direction of movement of the higher atmosphere. Moreover, during violent eruptions like that of January 14, 1908, the steam-column rose to an altitude of over 20,000 feet above sea-level. Under these circumstances it penetrated far above the level of a current of air from the pole northwards, so that its summit came well within the sweep of the higher wind blowing in a southerly direction, the result being that the steam-cloud in this region was dragged over powerfully towards the south-east. On such occasions one usually saw evidence of two high-level currents, the one coming from a northerly direction, its under limit being about 15,000 feet above sea-level; and the other, or middle current, from a southerly quarter, usually blowing towards the east-north-east, having its upper limit at 15,000 feet normally, while its lower limit was between 6000 and 7000 feet above sea-level. While these two currents were blowing strongly, there would frequently be a surface current blowing gently from the north. This would bring up very dense masses of cumulus cloud from off Ross sea. The cumulus would drift up to the 6000 or 7000 feet level on the north-west slopes of Erebus, and then the tops of the cumulus would be cut off by the lower edge of the northward-flowing middle current. Wisps of fleecy cloud would be swept along to the east-north-east, torn from the tops of these cumulus clouds by the middle current. Our observations showed that during blizzards the whole atmosphere from sea-level up to at least 11,000 feet moves near Cape Royds from south-east to north-west, and the speed of movement is from 40 up to over 60 miles an hour. After and during the blizzard the middle air-current, normally blowing from the west-south-west, is temporarily abolished, being absorbed by the immense outrushing air-stream of the south-east blizzard. During a blizzard the air was generally so thick with snow that we were unable to see the top of Erebus. At the end of a blizzard the air-current over Erebus became suddenly reversed, the steam-cloud swinging round from the south to the north. After a time, following on the conclusion of a blizzard, a high-level current was seen to be floating the cirrus clouds from the south-east towards the north-west, and the steam of Erebus would stream out towards the north-west. We could not account for this high-level south-easterly current. It looked like a reversal of the usual upper wind, and it appears to be a fact new to meteorological science."

In this article I can only indicate the scientific results of the expedition, as apart from the new geographical knowledge secured. We were able to throw some additional light on the problem presented by the Great Ice Barrier. The disappearance of Balloon bight shows clearly that the recession noted since the days of Sir James Ross continues, and suggests that very large portions of the Barrier edge

may occasionally "calve off." The trend of the mountains discovered on the southern journey indicates that the Barrier is bounded by mountains which run eastward along the 86th parallel, about 300 miles from the sea-edge. The great glacier up which we marched to the polar plateau shows that the Barrier is fed to some extent from the highlands of the interior. It would seem, however, that in the main the Barrier is formed of superimposed layers of snow, and some interesting observations were secured in this connection. We formed the opinion that at Cape Royds the annual snowfall is equal to about 9·5 inches of rain. The southern depôt party, in January, 1909, found depôt A, left by Captain Scott in 1902 on the Barrier off Minna bluff. A careful examination showed that the depôt had been moving bodily to

PROF. DAVID, DOUGLAS MAWSON, AND DR. MACKAY AT THE SOUTH MAGNETIC POLE.

the east-north-east at the rate of a little over 500 yards a year, while there had been an accumulation of about 13 inches of hard snow above the depôt during each year. A determination of the density of the snow showed that the snowfall on that part of the Barrier had been equal to about 7·5 inches of rain per year. If it is assumed that the rate of accumulation of solid snow over the Barrier is 12 inches of consolidated snow per year, then it follows, since the Barrier extends south for about 300 miles, and is moving northward at the rate of about one-third of a mile per year, that a layer of snow deposited 300 miles inland will be covered by a depth of 900 feet of snow when it reaches the Barrier edge 900 years later. This theory suggests that the Barrier is an accumulation of snow rather than of glacier ice, and was supported by the

evidence of bergs which were examined by the expedition. The typical Antarctic berg is formed of consolidated snow. The question of what becomes of the ice from the inland glaciers remains unanswered. The Barrier is certainly afloat at its northern edge, and perhaps the ice, weighed down by superimposed snow, is thawed away by the sea-water. Some true icebergs are found in the Antarctic.

The expedition made a special study of meteorological optics, and some very interesting observations were made, and will be dealt with by the scientific members in the memoirs. The curious "earth shadows" were observed in a variety of forms. Some of them seemed clearly to have a relation to the relative positions of Mount Erebus and the sun. Other forms were not so easily explained. In the spring, when the sun was low in the northern sky, we saw above us six parallel earth-shadow beams, directed from the sun.

The scientific memoirs of the expedition will deal in detail with geology, biology, meteorology, magnetism, physics, chemistry, and mineralogy, tides and currents, optics, and other scientific subjects. We were a small party, and of necessity a considerable part of our time was occupied in the necessary routine duties incidental to daily life in the Antarctic, but we tried to cover all the ground possible in the various branches of scientific knowledge. It is probable that most of the volumes containing our scientific records and conclusions will be published within the next twelve or eighteen months.

The last stage of the expedition was a search by the *Nimrod* for some of the charted southern islands, the existence of which is doubtful. The ship sailed over the positions assigned to the Royal Company island, Emerald island, the Nimrod islands, and Dougherty islands, without having sighted land.

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## CHANGES ON THE EAST COAST OF ENGLAND WITHIN THE HISTORICAL PERIOD.

### I. YORKSHIRE.*

By T. SHEPPARD, F.G.S., The Museum, Hull.

#### Coast Changes in Holderness and the Humber Estuary.

Possibly no district in the British Isles offers such a variety of lessons as does the coast-line between Bridlington and Spurn Point and the Humber estuary. On the one hand, enormous tracts of land have disappeared within historic times; whilst on the other, large areas have been formed, embanked, and cultivated.

The district is also especially worthy of attention from the fact that data of a most reliable character relating to these changes are available.

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* Research Department, June 17, 1909.

A short time ago, at the request of the Royal Geographical Society, I prepared a bibliography of papers, books, maps, etc., bearing upon the district.* This was printed by the Hull Geological Society, and copies were sent to the Geographical Society. More recently I have been asked by the Hull Corporation to prepare a list and description of all the known plans relating to Hull and district. This work is practically complete, and will shortly be published by the Corporation.

The compilation of these two lists has resulted in an enormous mass of material being brought together, an examination of which throws an important light upon the recent geological history of the neighbourhood.

The district may be divided into sections, as under:—

1. The Holderness coast from Bridlington to Kilnsea.
2. Spurn point.
3. The North Humber shore.
4. The South Humber shore.
5. The Humber itself.

In dealing with these respective areas, reference can be made, first, to geological evidence; secondly, to historical evidence; thirdly, to evidence from actual measurement.

### Geological Notes on the District.

If we carry our minds back to that remote (though, geologically speaking, recent) period before this country was invaded by glaciers during the Great Ice Age, we should certainly find a change in the coast-line of this district, almost startling in character. In pre-Glacial times a line of chalk cliffs, averaging 100 feet in height, extended from Sewerby, near Bridlington, through what is now Driffield, Beverley, and Cottingham, to Hessle.† It also continued across Lincolnshire to Donna Nook, though its precise position in that county has not been so clearly traced as in Yorkshire.

The very place at which the pre-Glacial cliff joins the present cliff-line can be clearly seen at Sewerby to-day; and the sea, year by year, washing away the glacial *débris* which has hidden the old cliff for so long, is once more bringing it to light of day. Some years ago Mr. Lamplugh conducted a series of excavations at Sewerby, exposing the whole pre-Glacial beach and blown sands, and from it were obtained bones of reindeer, rhinoceros, *Elephas antiquus*, hippopotamus, etc., many of which had been gnawed by hyenas. Later still, at Hessle, at the southern extremity of the Yorkshire cliff, some excavations for

* "List of Papers, Maps, etc., relating to the Erosion of the Yorkshire Coast, and to changes in the Humber Estuary," *Trans. Hull Geological Soc.*, vol. 6, part i., pp. 43-57.

† Reid, 'Geology of Holderness;' Lamplugh, 'Drifts of Flamborough Head;' Walton, "Gravels at Hessle," in *P. Yorks. G.S.*, 1894, p. 396; Kendall and Crofts, in the *Naturalist*, September, 1906, p. 340.

gravel exposed the angular chalk-wash, or grut, banked against the cliff face, and from it I obtained bones of rhinoceros, elephant, horse, reindeer, etc. More recently excavations on the side of the North-Eastern Railway have exposed the actual junction of the cliff-line and the pre-Glacial Humber shore, and not only was the over-lying chalk "grut" excavated, but the water-worn beach pebbles and the original shelving chalk floor were exposed.

Perhaps the most interesting features connected with the exposures made on the site of the old cliff is that, in pre-Glacial times, the beach-level, in this part of the country at any rate, was practically the same as it is to-day.

Other striking features are the extraordinary accumulations of blown sand and angular chalk-wash, and also the large number and variety of mammalian remains discovered, having regard to the comparative smallness of the excavations made. From this cliff-line, as has been proved by a careful comparison of the records of innumerable borings, the original chalk floor of Holderness Bay gradually shelved from the cliff foot eastwards.

From the same evidence, as well as from actual exposures on the present Humber banks, it is clear that in pre-Glacial times that river had an outlet of no mean importance; but instead of following its present somewhat irregular course, it then flowed straight out to sea, the site of its mouth being across what is now Holderness. Unquestionably in pre-Glacial times the Humber was a feature of greater importance than it is to-day, and probably discharged the waters of even a greater area than its present basin.

With the oncoming of the ice the entire geography of the district changed. In the first place, it is probable that, as the Scandinavian and Scotch ice encroached upon the North sea, the water in that exceedingly shallow basin would recede, and in this way the beach at the foot of the old Holderness cliffs was transformed into great sand-dunes—the feeding-ground of the hyenas and other carnivores. Evidence of the approaching cold is supplied by the enormous accumulation of fine, angular, chalky wash, the result of frosts and thaws, and containing occasional land-shells which came over the cliff edge and covered up the beach below in the form of a huge *talus*. The advancing ice, with its boulder clay, sand, and gravel, eventually overrode the cliff-line, plastered its front with clay, and on its final melting the whole aspect of the country was altered. The thick deposit of drift entirely obscured the old cliff-line, and not until quite recent years was its existence even dreamt of. The great heap of morainic rubbish,* left to the east of the cliffs, formed an irregular strip of country sufficiently

* Sheppard, "On Another Section in the So-called Interglacial Gravels of Holderness," *P. Yorks. G.S.*, vol. 13, p. 189.

high, in its eastern extremity at any rate, to keep the North sea entirely out. North of Flamborough headland, rivers originally flowing eastward had their outlets dammed by glacial *débris*, and the waters were diverted westward and southward to find an outlet by means of the Humber. Large extra-morainic lakes, which had been formed whilst the ice was impinging on our shores, were now emptied, and have left behind fans of gravel and other evidences of the rush of waters at their disappearance. Perhaps one of the most important features of the district would be the enormous lake formed by the blocking up of the Humber mouth, to which the name Lake Humber was given by Carvill Lewis.*

The Humber's present irregular course was doubtless defined by the nature of the morainic material left behind on the melting of the glacier. The great mound at Paull, upon which the battery is built, probably proved an obstacle to the direct easterly course of the river, and consequently the waters were diverted in a south-easterly direction, thus making Grimsby possible as a port. At Red Cliff, near North Ferriby, and on the Humber bank at South Ferriby, are the severed extremities of a moraine which once crossed the Humber at these points, and would unquestionably interfere with its drainage; whilst on the top of Mill Hill, at Elloughton, at an elevation of 100 feet, a mammaliferous gravel has yielded evidence of having been formed on the shore of an inland lake.†

After the final melting of the ice and the emptying of the pent-up waters, the district would begin to assume something of the form that is familiar to us to-day. The coast-line, however, was some miles to the eastward of its present position. Spurn Head was not formed, Sunk island, Broomfleet island, Reed's island, and other reclaimed lands in the Humber were not then known; and certainly large tracts of country (such, for instance, as the valley of the river Hull), being below the sea-level, were subject to tidal influence, and only became habitable by a process of natural silting-up, which is now artificially copied in some parts of the district by the system of warping. Holderness itself, however, even until historical times, presented an appearance something like that of the Norfolk Broads of to-day. It was a land of meres and marshes, the gravel mounds standing out as islands in all directions. In addition to the actual deposits themselves, which are often cut through during drainage operations, and are also exposed in the cliffs, there are numerous evidences in the place-names of the former appearance of the country. Amongst these may be mentioned *Mar*ton,

* 'The Glacial Geology of Great Britain and Ireland,' 1894, p. 62. See also F. R. C. Reed, 'The Geological History of the Rivers of East Yorkshire,' 1901.

† Lamplugh, "Mammaliferous Gravel at Elloughton, near Brough," *P. Yorks. G.S.* 1887, p. 407; and Sheppard, "*Elephas antiquus* and Other Remains from the Gravels at Elloughton, near Brough," *P. Yorks. G.S.*, 1896, p. 221.

near Burton Constable; Sand-le-*Mere* or Sand-le-*Marr*, near Withernsea; *Mar*fleet, near Hull; Long*mar*hill, near Welwick; Bow*mere*hill, in Owstwick; Pil*mar* Lane, in Roos; Withernsea *Mere*; Row*mere* and Gilt*smere*, in Tunstall; Red*mere*, in Preston; Brae*mere*, in Flinton; "The *Marrs*," in Swine; Cross*mere*hill, in Aldborough; Sou*mers*, White*marr* and Bass*marr*, in Skipsea; Brae*marr* Drain, in Beeforth; Gunny*marsh* Drain, in Ottringham; Hay*marsh*, in Preston; Green*marsh*, in Camerton; Slight*marsh* and Ryehill *marsh*, in Ryehill; Ottringham *marsh*; Atwick *marsk*; Sally*marr*, near Burton Constable; and the *Marsk*, in Nunkeeling. Goose island, near Ulcome, is a hillock surrounded by cornfields, the place being no longer an island.

Even in mediæval times the "Isle of Holderness" could be circumnavigated by vessels entering near Barmston and coming out again at the river Hull.

Some indication of the climatic and physiographic changes that have taken place in the district between the close of the Glacial Period and the present time, can be deduced from an examination of the semi-fossil lacustrine deposits, of which there are a great number in the district. At various points along the coast, as at Out Newton, Withernsea, Sand-le-Mere, Hornsea, Atwick, etc., the sea has from time to time exposed sections of these old lake-beds. Some of these have since entirely disappeared, though fortunately details of their contents have been recorded. Others from time to time are opened out as the cliff recedes, whilst inland sections can be seen on the banks of streams or as they are exposed during agricultural operations.

To take a typical example, we find that resting directly on the Boulder Clay is usually a deposit of fine lacustrine marl containing numbers of the swan mussel (*Anadonta cygnæa*), etc. In this deposit remains of the Irish elk (*Cervus megaceros*) are occasionally met with, and the single record of a reindeer antler from the peat at Withernsea is probably from this bed. The traces of vegetation immediately associated with it have yielded remains of the dwarf Arctic birch (*Betula nana*), etc., both flora and fauna indicating the somewhat cold conditions we should have expected just after the Glacial Period.

As we ascend in the sequence, we find evidence of an ameliorating climate. The Scots fir, oak, hazel, etc., make their appearance; and amongst the animals we find the red deer, horse, and *Bos primigenius*. The associated marl-bed contains quantities of Chara, and an extensive molluscan fauna, though this seems to be the same as that existing in Hornsea mere to-day; that sheet of water being the last survivor of many meres that once existed in Holderness. Such fish remains as are recorded are referable to the pike and perch, and the few records of the invertebrate fauna, principally Coleoptera, also indicate that the conditions in those days were not very dissimilar to those obtaining now.

### Lake Dwellings.

Holderness also gives evidences of the district having been occupied by man in very early times. In 1880 Mr. Thomas Boynton noticed that a number of artificially worked bones were being thrown out by his workmen during drainage operations, and he caused a series of systematic excavations to be made, resulting in the discovery of a pile dwelling, 90 feet by 60 feet. It was further noticed that the lower piles had been crudely pointed by burning, etc., apparently before the introduction of metal. In the lower layers objects of stone and bone only were found. The original structure seems to have been destroyed by fire, or in some other way, and upon its ruins a second was erected, which, from the sharply pointed piles, the associated relics (including a bronze spear-head), was apparently built during the Bronze Age. The dwelling had evidently originally been erected at some distance within the lake, and was connected with the mainland by a sunken causeway. The animal remains found associated with it were the horse, the ass, *Bos longifrons*, *Bos primigenius*, pig, sheep, goat, deer, dog or wolf, fox, beaver, otter (?), with geese and other birds.

At Sand-le-Mere and other places traces of a lake dwelling have also been recorded.*

Indirectly, the contents of the pre-historic burial mounds on the Yorkshire wolds give an indication of the former geographical conditions, the animal remains found (beaver, wild boar, red deer, etc.) indicating that the appearance of the district was formerly very different from what it is to-day.

### Historical Evidence.

The information relating to changes in the district from historical evidences may be classified under three heads: (1) that of Domesday and other documentary evidence; (2) that supplied by old maps and plans; (3) that obtained by comparing old measurements from various points of the cliff with those of to-day.

1. *Domesday.*—In a short note,† the late J. R. Boyle gives some interesting information on this point. He opines that Canon Isaac Taylor, in his paper on "The Ploughland and the Plough," has conclusively proved that in Domesday Book, two- and three-field manors are distinguishable by the relative number of carucates and ploughs. In three-field manors the average number of ploughs is equal to half the number of carucates, whilst in two-field manors the number of ploughs and carucates, as a rule, is the same. The same writer has shown that, in Yorkshire at least, the carucate is a definite measure of arable land.

* Sheppard, *Naturalist*, 1893.

† *Trans. Hull Geological Society*, vol. 3, 1895–1896, pp. 16–17.

The Domesday measurement formed the basis of taxation, and as in a two-field manor, in any year, only half the arable land was in culture, it follows that the Domesday measurement in such cases represent only one-half of the actual arable area. In three-field manors, on the other hand, as only one field lay fallow, the Domesday measurements represent two-thirds of the whole arable area. Canon Taylor has further shown that the amount of arable land in a Yorkshire manor, at the time of the survey, was practically identical with the extent of such land at the period of enclosure.

Easington, Holmpton, Tunstall, and Colden were evidently two-field townships.

In Easington there were 15 carucates of land to be taxed. This gives 30 carucates in the two fields, equal to 2400 acres. At the enclosure in 1770, the township contained 1300 acres of arable land, 1100 acres having been washed away by the sea since the time of Domesday.

In Holmpton there are 8 carucates in one field, which for the two fields gives 1280 acres. At the enclosure in 1800, there were 900 acres of land, 380 having been lost since 1086.

In Tunstall there were 7 carucates in soke to Kilnsea, and 1 carucate in soke to Withernsea, or 8 in all, equal to 1280 acres in the two fields. At the enclosure in 1777 there were 800 acres of arable land, 480 acres having been washed away.

In Colden there are 12 carucates, equal to 1920 acres, in the two fields. At the enclosure, 1770, there were 1100, leaving 820 which had been lost since 1086.

It may be fairly assumed (1) that, taking a considerable number of townships, the average relation between the area of arable land would not greatly vary, and therefore (2) that the loss of arable land in the coast townships of Holderness will indicate to a fairly accurate extent the loss of other lands.

Adopting the data for the determination of Domesday areas, above indicated, it is possible to compare the extent of arable land in four coast townships of Holderness in the year of the survey, A.D. 1086, and, say, the year 1800 :—

| | 1086 | | 1800 |
|---|---|---|---|
| Easington ... ... ... | 2400 acres | ... | 1300 acres. |
| Holmpton ... ... ... | 1280 „ | ... | 900 „ |
| Tunstall ... ... ... | 1280 „ | ... | 800 „ |
| Colden ... ... ... | 1920 „ | ... | 1100 „ |

The coast townships of Holderness now contain 33,468 acres. Assuming that the waste of other kinds of land has been equal to the arable lands in the other townships, besides the four above named, the sea has carried away 22,694 acres, or over 35½ square miles. The coast of Holderness from Barmston to Kilnsea is 34½ miles long. If the lost land is assumed to have been carried away to an equal extent

throughout this distance, it accounts for the loss of a strip of 1809 yards, or a little over 1 mile wide, or at the rate of 7 feet 1 inch *per annum*. If the denudation from the period of the Roman occupation of Britain has gone on at the same ratio, 53,318 acres, or about 83 square miles, equal to a strip 2½ miles wide, have been lost.

It is important to note that this estimate agrees exactly with the proved disappearance of the land in recent years by actual measurement.

From a gaudily coloured "Plotte made for the description of the river Humber and of the Sea and Seacoost from Hull to Skarburgh," in the late years of the reign of Henry VIII. or in early Elizabethan times, Hornsea is shown at a considerable distance from the sea, and is connected with the coast by a long straight river or creek. Apparently this is connected with the sea, and the plan would lead one to assume that it might be used as a harbour for small craft. A very careful examination of the present fauna and flora of the Mere, however, and of the old Mere deposits which have been excavated, has failed to produce any evidence whatever in favour of the sea ever having access to the Mere. In fact, the testimony is fairly complete to show that fresh-water conditions have always obtained. The map is interesting also as distinctly showing a pier immediately north of the stream, and a number of churches and other buildings, which have also entirely disappeared. This plan, however, will be dealt with in detail later, but its representation of Hornsea is of interest at the present moment, as indicating (what has been ascertained from other sources) the importance of that place as a port in early times. The present Hornsea, of course, is a place altogether apart from the Hornsea of the sixteenth century.

About 1228 Walter de Spiney gave to Meaux Abbey his "whole profit of merchandise and of every ship applying at the port of Hornsea." It seems that Walter de Spiney's power of making such a grant was disputed, the profits collected on vessels lying north of Hornsea beck apparently belonging to the domain of Hornsea, whilst south of the stream they belonged to the lord paramount of Holderness. Consequently, the occupants of Meaux Abbey did not receive the benefit of these tolls.

The pier at Hornsea is referred to in a petition of 1558. From an inquest held (7 James I.) it appears that this structure had cost £3000, a very considerable sum in those days, and that 2500 tons of timber had been necessary to repair it.

A previous inquisition held at Hedon in 1400 showed that in 1334 Meaux Abbey held at Hornsea Burton 27 acres of arable land, for which they received 2*s*. per acre in rent, but of which at the close of the century about an acre remained. Evidently in seventy-six years the entire 26 acres had been washed away. Similarly, in 1609 an oath was made to the following effect:—

"We find decayed, by the flowing of the sea, since 1546, thirty-eight

houses, and as many closes adjoining. Also we find two churches since centuries far from the sea. These were known, from the similarity of their architecture and from a tradition which connected the founders with close kinship, as the Sister Churches."

Owthorne church was then described as standing like a beacon on the cliff edge, and bones from the churchyard were washed out of the cliffs and strewn on the beach. The church, however, seemed to remain for some time, and though it was dismantled at the end of the eighteenth century, in 1816, after a heavy storm, it fell into the sea. In 1838 the whole of the churchyard was entirely destroyed, and in 1844 the vicarage and other houses disappeared.

### Lost Towns of the Coast.

Right along the coast we find that many places of importance, as well as smaller villages, have disappeared. Some, as at Kilnsea, Hornsea, etc., occupied positions to the east of the present townships bearing these names, the places gradually travelling westwards as their eastern portions were washed away. Others, such as Owthorne, Auburn, Hartburn, and Hornsea Burton, etc., have entirely disappeared.

### Erosion of the Holderness Coast.

On Tuke's map of 1786, and in papers and books innumerable, are details of scores of measurements from fixed points to the cliff edge. Without going into details, it may be said that these show that the actual wastage of the 30 miles of cliff between Bridlington and Spurn is 7 feet per annum. Near Hornsea the average loss appears to be 4 feet per annum; at Sand-le-Mere, Withernsea, and Holmpton, 9 feet per annum; and between Kilnsea and Spurn point, 6 feet per annum.

At various points along the coast, however, exceptionally heavy falls of cliff occur.

### Spurn.

The various capes and bays and other irregularities on the Yorkshire coast can, with one exception, all be explained by the theory of the survival of the fittest. Flamborough head, Filey Brig, etc., are hard masses of rock that have been left behind by the waves, whilst the softer material on each side has been denuded. The exception to this rule is Spurn point. This, instead of being a hard rocky promontory, as might be inferred from its shape as shown on the map, is a low-lying bank made of sand and shingle, which for its stability largely depends upon the roots of the marram grass, and groyns and other artificial methods of protection.

Spurn point owes its existence to the material washed down the Yorkshire coast, which falls on meeting the waters of the Humber. The southerly and easterly directions of the waters of the North sea

and the Humber respectively, define the shape of Spurn. Year by year the point extends southwards and westwards. The rate of growth can be ascertained by reference to plans, as well as, in recent times only, by actual measurement. On account of the shipping it is necessary that a lighthouse should be as near the extremity as possible. As the point grows, the position of the lighthouse has to be altered.

The following records from a paper by Mr. William Shelford* help us to form an idea of the rate of growth of the tongue of sand at Spurn :—

In 1428, Richard Reedbarowe, the hermit of the chapel at Ravensporne, obtained a grant to take toll from ships for the completion of a tower, which he had already begun, as a lighthouse.

In 1676 a patent was granted by Charles II. to a Mr. Angell for the erection and maintenance of certain lights at Spurn point, which lights were erected at the request of those interested in the northern trade, who represented that a broad, long sand had been thrown up at the mouth of the Humber six or seven months before. Smeaton thought that this sand had afterwards become connected with the mainland, and so formed the Spurn point of his day.

Greenville Collin's chart, 1684, shows Angell's lights at Spurn.

After 1684 the Point continued to increase in length, and the lights consequently became useless. An application was therefore made to Parliament in 1766 by the Trinity Houses of Hull and Deptford-Stroud, for the power to erect and maintain other lights, and was passed. At this juncture Mr. Smeaton was consulted, and recommended the erection of two lighthouses.

In 1771 Smeaton reported that Spurn point had extended 280 yards since 1766, and that it had increased on the Humber side, but diminished on the sea side to the extent of 50 yards. In the same year Smeaton's small lighthouse was founded, and in 1772 his great lighthouse, which is the old "high light." The small lighthouse appears to have been in danger from the first. These, of course, have now been superseded by the lighthouse erected at Spurn a few years ago.

Mitchell's chart, 1778, shows the old lights extinguished, and two temporary lights erected at the point.

In 1786 Smeaton made a survey of the Spurn, from which it appears that the high light was 1840 yards south of the position of one of Angell's lights, and was then 480 yards from the high-water mark at the end of the point, and that the point has also moved westward throughout its length.

Angell's lights are known to have been swept away by the progress of the sea, and one of them is so shown on Smeaton's survey of 1786.

The following summary of the history of Spurn lights will serve to prove the amount of this movement from time to time :—

* "Outfall of the Humber," *Proc. Inst. C.E.*, 1869, p. 472.

Smeaton's small lighthouse was built in 1771, 280 yards east of the high light. A second was built 70 yards further west in 1816. A third was built 30 yards still further west in 1830. A fourth was built 50 yards still further west in 1831, and in 1863 the sea had reached the high light itself, making a total westerly advance of 280 yards in ninety-two years, or 3 yards per annum. The low light in 1869 stood on the Humber side of the high light. The new lighthouse at Spurn is 71 yards north of that built in 1831.

According to Shelford, between 1676 and 1851 the southerly extension was 2530 yards, or 44 feet per annum. Between 1851 and 1888 the high-water line extended 600 feet in a southerly direction, or 17 feet per annum.* During the same period the westerly movement has been 8 feet per annum on the North sea side, and 17 feet per annum on the Humber side, a net increase of 9 feet per annum in the width of the point.

The foregoing information gives some idea of the rate of movement of the sand and shingle at Spurn. But it must be remembered that this is but a very small proportion of the material annually washed away from the Holderness cliffs; all the clay and a great proportion of the sand and pebbles find their way to the North sea.

There is no doubt that a time will come when the flow of the Humber waters will prevent the further southerly extension of the peninsula; or if the growth towards the Lincolnshire shore continues, a break must occur in the present sandbank. As it is, it is fairly clear that under favourable conditions pebbles, etc, are carried across the estuary to Lincolnshire. No doubt such changes have frequently taken place; on more than one old chart an island is shown where the peninsula now is. And is it not possible that the old town of Ravenser, which existed on an island at the Humber mouth, but which was gradually washed away, may have had its foundations on a portion of Spurn point at one of these critical periods of its career?

### Hedon.

This once flourishing seaport, which sent three members to Parliament, and still possesses valuable corporation plate including the oldest mace in the country, is now a quiet country town of 1000 inhabitants. It is to-day distant from the Humber some 2 miles, though the old docks and waterways can still be traced in fields now used for grazing. Its official seal—a sailing-ship, manned—seems to be all there is with its one-time connection with the sea. To-day a narrow, meandering creek, at high water, allows small craft to approach a town which once supplied ships and men to the King's navy.

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* Butterfield, *Naturalist*, November, 1904, p. 326.

### Hull.

The story of Hull itself, though one of continued growth and prosperity, also has its interest from the physiographical changes which its old records indicate. In the earliest times, what is now the river, Hull certainly had two mouths, the "old town" itself being built upon the delta. The records also show that in the immediate vicinity of the town the land was formerly of a marshy character, and in many places absolutely impassable. Advantage was taken of this state of things during the civil war in 1642, when, by a series of sluice-gates from the Humber and the Hull, it was possible to entirely flood the country. The various plans of the town and district, of which an exceptionally complete series is available, further assist us in forming an idea of the changes that have gone on with the growth of the town.

This town has much changed since it was a small ville called Wyke; that was before the days of King Edward I. In mediæval times it was a walled and moated stronghold, of some consequence in the civil war. Early in the eighteenth century the old wall and moat and adjoining lands were handed over to the old "Hull Dock Company," and upon their site was built a line of docks. This accounts for the "Old Town" of Hull still being an island connected with the land outside by bridges. As time went on these docks were too small for the town's requirements, and new docks were made, and are still being built, to the west and east of the town. These are along the Humber side, their construction resulting in retaining walls being built into the Humber, thus considerably extending the town's frontage southwards. "Sand South End," where less than two centuries ago the obstreperous ladies of Hull were ducked into the Humber by means of the ducking-stool, is now well inside the "Old Town."

### Lost Towns of the Humber.

Just as thousands of acres of new land have been formed within the Humber estuary in comparatively recent times, so in the past we find villages, and even flourishing towns, have disappeared. In a volume on 'The Lost Towns of the Humber,' the late J. R. Boyle brings forward unquestionable historical evidence of many important places having existed on sites which are now within the waters of the estuary, or have been more recently covered up by the accumulation of mud-flats. Upon a map which forms a frontispiece to the volume are indicated the positions of Tharlsthorp, Frismersk, East Somert, Penisthorp, Orwithfleet, Sunthorp, Ald Ravenser, and Ravenser Odd.

### Ravenser.

This place is described as unquestionably originally a Danish settlement. The first part of the word refers to the Danish standard,

a raven, and the second portion, *eyr* or *ore*, "denotes a narrow strip of land between two waters." Attention is drawn to the interesting fact that Ravenser is referred to at least three times in ancient Icelandic literature,* in connection with the battle of Stamford Bridge, references to which in the Saxon Chronicle are well known.

### Erosion in the Humber.

Generally speaking, the erosion within the Humber is not very serious, except between Winteringham and Barton, where the growth of Read's island has resulted in the waters impinging more upon the Lincolnshire coast, with fairly disastrous results.†

### New Land in the Estuary.

As years go on the Humber is confined to narrower and narrower channels. A few centuries ago, large tracts of land were under water. These are now annually producing good crops, having been reclaimed and embanked. Earlier still the valleys of the Hull, Ancholme, and other large areas, were arms of the Humber, influenced by the tides, and Hull itself is built on an accumulation of silt, which was not existing in Roman times.

Not only have these connecting valleys been silted up, but great tracts of land on both the north and south banks have been reclaimed; some probably so long ago as Danish times, some more recently. Of comparatively late date are those large areas, Sunk island, Broomfleet island, and Read's island; though the last-named only is now an island proper.

The growth of Sunk island can be easily traced by an examination of the various maps and charts of the Humber that have been published from time to time. In the earliest of these a mere sandbank is shown; then an island, which increases in size until eventually the channel

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* The following passage relating to the departure of the fleet from Ravenser is of interest in this connection:—

"Olafr, son of Harold Sigurdson, led the fleet from England, setting sail at Hrafnseyri, and in the autumn came to Orkney. Of whom Stein Herdisson makes mention.

"The king the swift ships with the flood
Set out, with the autumn approaching,
And sailed from the port called
Hrafnseyrr (the raven tongue of land).
The boats passed over the broad track
Of the long ships; the sea raging,
The roaring tide was furious round the ships' sides."

† For a summary of the erosion records in the estuary collected by the British Association between 1899 and 1904 see the *Naturalist*, February, 1904, pp. 51, 52.

between it and Holderness is silted up, and the whole is joined to the mainland.

So long ago as 1660 two large sandbanks were shown to the west of Paull, and the gradual growth of these has resulted in the addition of about 7500 acres of excellent farm land to this part of the county. In 1744, 1561 acres had been enclosed; twenty-six years later "Cherry Cob sands" were enclosed; further reclamations were made in 1826, and 1850, and in 1880 a further 2700 acres were reclaimed.

More recently, in 1897, Mr. G. Bohn embanked 347 acres, and at the present time is reclaiming a further 170 acres.

A century ago large accumulations of sand were formed on the north Humber shore west of Brough. By 1820 they had reached a level above high-water mark. In 1846 James Oldham reported on enclosing 130 acres. But soon afterwards the land began to disappear. The whole island went, as well as part of the mainland. In 1853 it began to accumulate again, and thirteen years later 6 acres were enclosed. In 1870 there were 60 acres embanked: the channel between the island and the mainland gradually silted up, and by 1900 was entirely closed, and now nearly 600 acres have been added to the county at this point.

Read's island, still an island, is off South Ferriby, Lincolnshire. The channels on either side, however, vary, in my own time the shipping having had to change its course from one side to the other two or three times. The island commenced to form early in the nineteenth century. In 1840, 75 acres were enclosed; in 1861 there were 289 acres embanked; in 1886, 491 acres, 450 of which were enclosed. Since that date the island seems to have ceased growing, and is being washed away at an average rate of $4\frac{1}{2}$ acres a year, 67 acres having disappeared between 1886 and 1901.

### Thorne Moor and Hatfield Chase.

To the west of the Humber estuary are large areas of land, now partly cultivated and productive, which formerly were watery wastes. These were transformed largely during the reign of Charles I. by Vermuyden. A geological study of these areas gives interesting details of the former aspect of the district round Goole, Thorne, and Doncaster. Large tracts are now being excavated for peat.

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# NOTES ON A JOURNEY THROUGH PORTUGUESE EAST AFRICA, FROM IBO TO LAKE NYASA.*

By Major J. STEVENSON-HAMILTON, F.R.G.S., late 6th Inniskilling Dragoons.

DURING July and August of last year (1908), in company with Mr. R. C. F. Maugham, H.B.M.'s Consul for the Mozambique province, I undertook a short journey through the above territory. Our original idea had been to march due east from Ibo, emerging at Mtengula on the lake, but political and other reasons subsequently obliged us to modify this programme, and to choose a slightly more southerly route, leading us to Fort Maguire, in British territory. A small staff of some half-dozen personal servants accompanied us from Lorenzo Marquez, who later proved invaluable in keeping the machinery of the expedition well oiled.

At Kissanga we picked up sixty porters, collected for us through the kindness of the governor of the Nyasa province, together with a few "sepoys," as the native soldiers of the company are called. Our caravan consisted at first principally of coast natives, men of mixed blood and unsatisfactory character, so that we had a good deal of initial trouble, culminating in wholesale desertions, partly, no doubt, to be ascribed to fear of the semi-hostile chiefs of the interior, through whose territory we had to pass. We therefore made the best of our way to Meza, beyond the source of the Mwagidi river, where our gaps were filled up with Makuas from the Medo district, many of whom accompanied

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* Map, p. 592. Major Stevenson-Hamilton writes:—

"Most of my observations agreed very well with those of Mr. Last, wherever our routes converged; but there is one spot where I cannot make things harmonize. This is a point on the Lujenda river, between the 13th and 14th parallels. From the Ngweweni (Ndwini) river to the junction of the Luambala with the Lujenda, Mr. Last makes the distance 21 geographical miles, while I cannot make it more than 15. It took us five hours only to march the distance between these two points (ordinary walking), and, as the Portuguese map we had with us gave Last's distances, we were completely out in our calculations for that day. The discrepancies are constituted as follows:

LAST.

From Ngweweni (Ndwini) to Luiati ... ... ... 16 geog. miles.
From Luiati to Luambala ... ... ... ... ... 5 „ „

SELF.

From Ngweweni (Ndwini) to Luiati ... ... ... 6 geog. miles.
(Two hours' ordinary walking.)
From Luiati to Luambala ... ... ... ... ... 9 geog. miles.
(Three hours' ordinary walking.)

"I took latitude observations between the Luiati and the Luambala, and again at Mluluka, at the Luambala junction."

us right through to Nyasa. Thence the route continued between the 13th and 14th parallels, until Lake Nyasa was reached in twenty-four marching days.

*The Country.*—By a charter dated September 21, 1891, a region bounded on the south by the Nyasaland Protectorate—from the lake of that name at the Lafuthi stream, as far as the Lurio river, thence following the unknown course of the latter to its mouth, on the east by the Indian ocean, on the north by German East Africa, and on the west by Lake Nyasa—was transferred on concession by the Portuguese Government to the Nyasa Chartered Company. The capital and seat of administration of this large territory, probably exceeding 80,000 square miles in extent, is at Ibo, situated upon a small island of the same name, about 1½ mile from the mainland. The coast-line possesses many bays and inlets, varying in importance from the magnificent Pemba bay, probably the finest harbour on the east coast of Africa, and one within which the navies of all Europe might well find a secure refuge, to the river-mouths of the Rovuma, Msalu, Mtepwesi, and Lurio, all mere inlets. There are also a host of small islands at points along the coast, which in the good old days served useful purposes in connection with the slave trade. Generally speaking, the country has not been the subject of any very thorough and extended geographical research. Since Livingstone followed out the course of the Rovuma in the north various travellers and explorers have at intervals of time visited the country and made lines through it in different directions. The principal among these have been Archdeacon Johnson, between 1876 and 1883; the Rev. Chauncey Maples and Mr. Joseph Thomson in 1881, the latter having travelled up the Lujenda river to examine some alleged coal deposits. In 1886 and 1887 Mr. J. T. Last carried out the most extensive survey which has so far been made, and his work forms the basis of the cartography of the country at present; but, like all other mapping done before and since, it was throughout the greater part route work only.

YAO NATIVE FROM LUJENDA.

Since Mr. Last's time but little has been added to our geographical

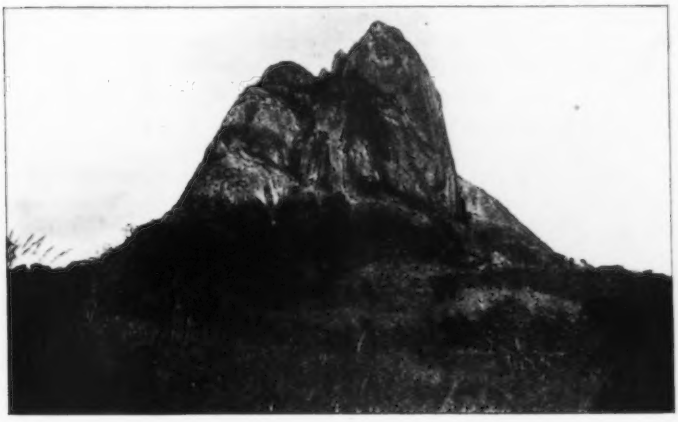
knowledge of the province. Some ten years ago a scheme was mooted to run a railway from Pemba bay to Lake Nyasa, and a well-equipped expedition actually landed at Port Amelia, having with them a quantity of material for the proposed line. Nothing, however, seems to have been accomplished, and after a few months the expedition withdrew, and the railway material might have been seen during many years lying near the shore, a rusty heap of scrap iron; may indeed still be there. The route traced upon the maps as being the future course of the projected railway follows generally Mr. Last's outward route, but does not appear to have been surveyed in any way, and the line thus drawn by no means illustrates any actual apparent work performed. A few labour agents have penetrated the country here and there, but away from the coast itself but little recruiting can at present be done.

*Climate.*—The climate during the winter season (June, July, and August), except along the sea littoral, is of an equable nature, the thermometer seldom rising above 80° Fahr. by day nor falling below 50° by night. At a height of 4000 feet during the coldest month of the year we did not record any frost. South-easterly breezes were the rule. The rainfall would appear to be fairly abundant, judging from the rankness of the grass and undergrowth, and probably extends from about mid-November to mid-May. During our journey a little light rain fell at night upon two occasions, but was too slight to record. Probably, as is the case elsewhere, the rainfall over certain localities tends to diminish owing to the steady deforestation by the natives, and by the annual forest fires, which warp and destroy the sapling trees.

*Relief of the Land.*—After leaving the coast the ascent is very gradual for some 20 miles, notwithstanding that the forest-clad country undulates considerably. Presently high granite peaks begin to show beyond and above distant tree-clad foothills. The boldest of these, Jogola, rising in the south to a height of perhaps 2000 feet above sea-level, was noteworthy as being the first of the multitude of gigantic and quaintly formed granite peaks past which our path led us. Proceeding westwards, we marched through rather broken country, crossing the southern affluents of the Mwagidi river, eventually dropping down into the valley of the Muhupa and its tributaries. Generally speaking, little could be seen of the surrounding country, as the path was much overgrown, and the view restricted by the dense and monotonous forest of stunted trees, which covers almost the entire country. Occasionally, however, the eye was gladdened by a glimpse, caught through a gap in this rigid sameness of vegetation, of fantastic masses of rock rising abruptly from their under features, and suggesting sometimes gigantic cannon-balls, at others huge recumbent animals half sunk in a bed of forest. Thus were passed in the Medo district the lion couchant of Maramano, and the square, precipitous, table-topped body of Mekuti. Thence for about 20 geographical miles the

country is undulating, and gently rises to a height of 1600 feet as Mwiri is approached. This place, now the site of a small Portuguese fort, is situated in the vicinity of the Mtepwesi river, and is surrounded by some really magnificent hill features. The road leads us through the gorge between the great peaks of Nibua and Kirimba, which stand like sentinels upon either hand, and to north and south a jumble of broken hills and great outstanding peaks can be seen from the rising ground upon which the fort stands.

A day's march up the valley of the Mtepwesi brings us into the broken Umwalia country, where, though there is much to attract the eye, all else is for the moment forgotten before the astounding appearance of Mount Makua,* which, at a distance of 15 miles, and rising as



ISHRUNDU PEAK.

it probably does to a height of over 3000 feet above sea-level, looks exactly like the remarkably high pitched roof of an enormous cathedral, the illusion being heightened by the curious circular boulders correctly poised at the point of each gable.

Westwards to the Msalu the country is rather broken in places, and gradually attains an altitude of 1700 feet. Having crossed the latter river, a mountain system of most striking character is traversed. But first a magnificent and extended view may be obtained from the summit of the Chemariro peak, which rises 800 feet above the level of the Msalu. Having surmounted its slippery sides, formed of great boulders and convex slopes of granite, and having arrived panting upon the tree-clad plateau at the summit, the traveller stands silent before

* Called Serra Mekua or Mekwa by Portuguese.

the panorama of mountain scenery which unfolds itself from south-west to north-east. On the extreme left of the picture, and some 25 miles distant, the Chengwari hills extend like a rampart, and suggest nothing so much as the serrated battlements of some old-time city wall, smashed and broken by the engines of a besieger. Here is every conceivable and inconceivable form of natural architecture, except the table top, so common in South Africa, but seldom met with in these regions. The whole impressive picture has its culmination in the extraordinary "church spire" of Manjera. This marvellous obelisk shoots up straight for probably 800 feet above its parent peak, which itself dominates the features upon either side. Further to our right—that is, nearly due west—are the Kisanga and Chawo hills, whereof the maze of peaks defies definition. Prominent, however, in the fore-ground is Cherundu, an isolated mass of granite rising 1000 feet out of the plain in the form of an immense double cone. Further away, and more to the north, is the huge castellated fortress-like mass called by the natives Nomalobi; while on the extreme right of the picture lie the great though distant mountains known as Mkukutuku.

Two days are spent in getting through the Kisanga and Chawo hills, and the gradient is thence downwards through mountainous forest country to the Lujenda river. Following up the course of the latter, with occasional glimpses of distant hills beyond its western bank, the Luambala confluence is eventually reached, and here again the aspect of the country is very fine and bold, panorama after panorama of great mountain chains and isolated masses appearing to the northward. Thence the route becomes more and more difficult as the road ascends from the Msalala river to the village of the friendly Yao chief Katuri, situated at about 3000 feet above Ibo. After leaving Katuri's the paths are appalling, and the country so mountainous that progress was necessarily slow. Especially was this the case in making the descent from the Nyasa mountains, where we crossed the summit of the pass at an altitude of 4200 feet above mean sea-level at Ibo to the level of the lake—a drop of 2600 feet in about 6 miles.

To sum up, Portuguese Nyasaland may be very roughly described as a plain tipped over to the west and north as far as the Indian ocean and the Rovuma river respectively. The rivers in the south tend to run eastwards, while further north they find their way north and north-east either to join the Rovuma system, or, as in the case of the Msalu, to empty themselves into the Indian ocean. The mountain chains follow similar courses to the rivers, running, generally speaking, north-east and south-west, and after the low-lying coast belt has been left behind a fairly constant elevation of from 1400 to 1500 feet is maintained, the mountain chains crossed not leading the traveller to any conspicuously higher plateau beyond them. After crossing the Lujenda, the ascent to the summit of the Nyasa hills is comparatively gradual,

contrasting with the abrupt fall down to the lake of the western spurs.

*Hydrography.*—On the whole, the territory may be described as well watered, being drained by five important rivers, the Lurio, Mtepwesi, Msalu, Lujenda, and Rovuma, together with many smaller streams, a good percentage of which are perennial, whilst others yield a sufficiency of water a few inches below the surface of their sandy beds. Of those named, only the Lurio and the Rovuma have any claims to be considered navigable, and then for no great distance from their mouths. Notwithstanding the foregoing, there are nevertheless many areas quite destitute of water during the late winter season, and there the soil is unproductive, and vegetation stunted and poor.

MTSHUMBULI HILLS, NEAR NLULUKA.

The four river systems, *i.e.* the Rovuma with its great tributary the Lujenda, the Msalu, the Mtepwesi, and the Lurio, are all divided one from the other by very well-marked chains of hills, in which the various affluents take their rise, and which, as stated above, roughly follow the lines of the great rivers. The perennial streams, so far as our observations went, are of sluggish current, with sandy or muddy beds, while the forest, as a rule, grows close down to the banks, which are clean cut and well defined, and we saw none of those extensive reed-beds which are so marked a feature of many rivers in other parts of Africa. I am inclined to believe, from the general appearance of the banks, that the rise of the water during the wet season is pretty constant, and that there are few or no abnormal floods, certainly no tendency to spread beyond the banks. The wreckage found strewing the margins of rivers subject to periodical violent overflows, and the *débris* found collected.

amidst the lower branches of the bordering trees, are obvious indications during the dry season of their nature at other times of the year, but I could observe no such writing upon the banks of the rivers of Portuguese Nyasaland, so far as I had the opportunity of studying them.

There was an entire absence of lakes, and permanent "pans" of water. In places, especially amid the Kisanga hills, there is a good deal of swampy ground, which probably in the wet season is covered with several inches of water, but these marshy tracts are nowhere more than a few acres in extent.

*Geology.*—The formations are surprisingly constant, the prevailing one being of metamorphic granite rock, traversed by quartz reefs. In some of these felspars occur porphyritically, but the most common form encountered is a granite containing clear grains of quartz with orthoclase and black or brown mica. Here and there, as on the Lureko, sandstone outcropped, while at Umwalia there are indications of volcanic lava. There are no apparent indications of either clay, slates, or limestone, but coal is said to occur in certain portions of the western districts (probably the deposits examined by Joseph Thomson in 1881). In the hills near Mwiri were indications of graphite, while iron exists over most of the country, and is smelted by the natives. No trace of gold was observed, nor were there any indications of its existence either in reef or in alluvial deposit so far as could be seen. Among the hills bordering Lake Nyasa, in the vicinity of Mtengula, steatite, or soapstone, is found in immense quantities.

The central portion of the country might be described geologically as a plateau which forms the bed of numerous granite bodies, the latter being generally timbered sparsely with trees of little or no value. Considerable areas of granite sand cover portions of the plateau, which has a mean altitude of from 1400 to 1500 feet above mean sea-level at Ibo. It is noticeable at intervals that the parent stone has been intruded upon by dykes of more or less basic rocks, and this has given rise to considerable fissuring. Near the Anglo-Portuguese boundary, mountains of granite and others of gneiss are crossed, and considerable quantities of mica are seen in various places. The remarkable isolated and cone-shaped masses of granite which form such noticeable features of the central plateau, have no doubt arrived at their present elevation above the surrounding country as the result of denudation, so that it seems not improbable that, at no very distant geological date, the mean level of the land has been very much higher than at the present day.

*Animal Life.*—Much of the forest country traversed seemed almost destitute of animal life. Time, unfortunately, did not permit of any work being done in respect of the smaller mammals, so that it is impossible to say what may be the potentialities of the country in that direction. It was perhaps significant that all along our route there seemed to be a remarkable absence of squirrels and such lesser members

of the class as are wont most easily to catch the eye of the traveller. Primates, ungulates, and carnivores were certainly extremely rare. Between the coast and Meza were seen a few troops of yellow baboons (*Papio cynocephalus*) and a few monkeys (*Cercopithecus pygerythrus*). At Meza, and again near the Msalu, were indications of a few kudu and water-buck (which proved to be *Strepsiceros capensis* and *Cobus ellipsiprymnus* respectively) and occasional warthogs. A pair of duikers (a sub-species apparently of *Cephalophus Natalensis*) were noticed on one occasion. Elephants seemed to be fairly numerous in the north and north-east of the province, and between the Lujenda and the base of the Nyasa mountains, the tracks of these animals and of buffalo were not infrequent. Mr. Maugham saw a pair of hartebeeste (*B. Lichtensteini*)

MSALALA MOUNTAINS.

on the Lureko. I think the above represent the only occasions on which game, or indications thereof, was noticed, so that Portuguese Nyasaland —at any rate, so far as the part of it through which we travelled is concerned—cannot take rank as a hunter's paradise. Enough, however, was seen to indicate pretty clearly that the larger fauna differs in no marked manner from that found elsewhere at similar latitudes. Their natural food being scarce, the larger carnivora are likewise rare. A lion spoor, very old, was seen on the Lureko, and tracks of a hyena were once noticed. The nights were on no single occasion rendered melodious by the notes of either of the above animals, and we had to wait until reaching Lake Nyasa before we heard a jackal. Game birds, especially francolins, were likewise quite remarkably scarce. The East African guinea-fowl was encountered locally. But few birds of prey were seen, and I did not notice a single vulture. Lesser bird-life was

numerous near the rivers, and differed in no marked degree from that of the North-Eastern Transvaal, many South African species being found, and although there was in certain cases a leaning towards more northern types, and some purely East African forms were met with, I should say that the avi fauna was of the south rather than of the north. The yellow-billed kite, a winter migrant from South Africa, was met with in great numbers, as were pied crows and ravens (*C. albicollis*). The Nyasa mountains seem to form a barrier betwixt the birds east and west of them. Above 3000 feet birds of any kind become rare, and were found of certain types only, while the forest species east of the mountains appeared to differ in greater degree than the actual distance would warrant from those found at an equal altitude to the west.

I should be inclined to assign the comparative scarcity of large quadrupeds, except elephants, to the general rankness and coarseness of the herbage throughout the forest country, which, generally speaking, is not of a kind greatly favoured by grass-feeding animals, and also in some degree to the fact that so many of the natives are in possession of guns.

Tsetse fly was met with in two places, first, in a small belt near the Mwagidi river in the vicinity of the Makulu hills, and secondly, from the right bank of the Msalu to the right bank of the Lujenda river. Throughout the latter area fly was practically continuous, and, although it was the coldest season of the year, proved extremely troublesome. Contrary to the general assumption that this insect is dependent entirely upon the blood of the larger mammals for its sustenance, game throughout the fly belts in Portuguese Nyasaland was almost a negligible quantity. The individual Glossinæ collected were found to be members of the species *Pallipides*, which, to the naked eye, is almost indistinguishable from the better-known Morsitans. Grass ticks—perhaps owing to the season—were not conspicuous. The same cannot, however, be said of mosquitoes, which swarmed from the coast up to an altitude of about 3000 feet. A good many Anopheles were noticed at various places, and it is probable that, especially during and after the rains, there is no inconsiderable amount of malarial fever existent in the centre and east of the province. The valley of the Mutepwesi has the worst reputation in this respect among the Portuguese.

*Vegetation.*—Forest is practically continuous from the Indian ocean to Lake Nyasa, the individual growths with certain exceptions being poor and stunted. Near the coast, however, the vegetation is luxuriant. Much of the ground is cultivated, but elsewhere flourish euphorbias (*Candelabra*) and kigelias, baobabs, and wild date palms (*Phœnix reclinata*), while on every side are conspicuous the caucho, the guava, and the mango, established by the hand of man. Betwixt Ibo and Pemba bay lies the Ehari forest, extending for some 20 miles north and south, and, according to natives, a long day's journey from east to west.

Herein African teaks spring to a height of 60 or more feet, never a branch to mar the ramrod-like symmetry of the first 30 feet of trunk, but far overhead spreading out in such a manner as to pleasantly temper the rays of a tropical sun. Grove after grove of this splendid timber was passed, alternating with huge bamboos and dwarf ironwood, and occasional mahoganies and ebonies. Unfortunately, much that is valuable is here being rapidly destroyed. The natives are accustomed to ring the finest trees, burning them down when dead, in order that the ground may be cleared for their crops, and that the ashes may serve as a fertilizer therefor. In one place I saw over 100 acres of fine teak forest treated in this way. As one penetrates deeper into the forest, progress becomes increasingly difficult by reason of the dense under-

CROSSING THE LUJENDA.

growth and the creepers intertwined from tree to tree; there are no inhabitants, and apparently but little other life. The vegetation of the central plateau is remarkable, as compared with much of the South African bush, for the apparently total absence of thorn acacias. Typical genera are Brachystegia (Pectinata), Rhus (Longifolia), Eugenia (Guineensis), Combretum (Microphyllum), Landolphia, Afzelia, and Ficus. Nowhere, with the exception of the vicinity of the stream-beds, where valuable timber, such as mahoganies and ebonies, often grow, do the trees attain a height much exceeding 20 feet, while the majority appear to be undeciduous. Above 3000 feet a change becomes apparent in the character of the flora, though the trees remain generally stunted. At 4000 feet a quantity of light green moss or lichen adheres to leaves and branches, especially of the Euphorbias, of which several species are present, together with Cordyla, Cassia, Faurea, Brachystegia (Spicæformis)

in quantities, and a form of Protea with bunches of long finger-like fronds. One solitary oil palm was also seen at this height, but situated in a sheltered and moist depression between the hills.

*Anthropology.*—The coast having been left behind, the natives met with belong, in the eastern portion of the province, to various tribes of the Makua race, such as the Wamedo, Wandonde, and Mavia, extending about as far west as the Msalu river, which appears to form a rough dividing line between the Makua and the Wayao. The Makua, as he strikes the stranger on first acquaintance, is a rather sparely built man of average height—from 5 feet 6 inches to 5 feet 8 inches—individuals running a good deal taller, arms and legs not showing great muscular development, bones small as compared with those of South African natives, prognathous tendencies rather marked in a good many cases, chest development rather indifferent (here, again, there are marked exceptions), complexion very dark. Different tribes have different methods of tattooing; a number of small round marks upon the breast is not uncommon. The men wear a waistcloth of bark or of trade cloth, apparently fastened and worn according to the owner's caprice, and not in accordance with any particular national or tribal custom. Weapons are bows and arrows and stout spears about 4 feet long, but at the present day a large proportion carry flint-lock trade guns.

The women are adorned with a disc of wood attached to the upper lip, and known as a "pelele." This disc is inserted some time before the girl becomes of marriageable age, and is increased in size and weight as she grows older, so that it drags the lip down, in—according to our notions—a most unsightly manner. Nor did this custom compel admiration in the breasts of my Zulu-speaking policemen from the Eastern Transvaal, who, immensely amused, nicknamed the women "amadada" (ducks). In addition to wearing the "pelele," the married women paint their faces in perpendicular white streaks, so that altogether they present an appearance by no means fascinating. Knee petticoats of cloth or bark are worn by the fair sex, and the babies are slung on the back after the usual African custom. Although I should say that the Makua as a race are much behind the Zulu and Basuto peoples of South Africa, as well as their neighbours the Wayao, in point of mental as well as physical endowments, nevertheless they are by no means unintelligent. It is difficult to believe that their monotonous environment of dense stunted forest can have any very stimulative effect.

The marriage ceremony is said to be of a simple nature. The prospective bridegroom having paid the girl's father a stipulated amount in cloth, or other current commodity—sometimes before she is of marriageable age—on the day fixed for the wedding, the women of her family conduct her to her husband's hut. The dead are buried in a sitting position, and outside the villages. White is worn as a token of mourning. At present cloth and grain are the staple means of exchange

in the country, and, except quite close to the coast, money is not acceptable. I saw no bead ornaments among either the men or women met with. Many of the Makua near the coast profess Muhammedanism, as do practically all the coast people proper.

The most powerful of the independent Makua chiefs now are Umwalia, in the south of the Medo district, towards the Lurio, and Said Ali, not far from the coast, between Pemba bay and Ibo. Both are hostile to white men. Said Ali has been known to raid European caravans passing through his country; while Umwalia, who retired towards the Lurio upon the Portuguese building a fort near the site of

LONG GRASS NEAR LUJENDA.

his town, refuses to pay taxes, and occasionally makes hostile demonstrations against one or other of the entrenched posts. Such of the Makua as have admitted the authority of the Chartered Company have concentrated near the various forts of the chain, while the remainder have retreated to forest and mountain fastnesses north and south of that line. Intermittent warfare goes on. The Makua dwellings are small circular huts of the usual African, conical-roofed or mushroom pattern; thatched; sometimes, but not always, plastered; and with no capping piece on the apex of the roof.

The Wayao, who occupy the country, roughly speaking, from the Msalu river westwards, and are divided into many tribes or clans,

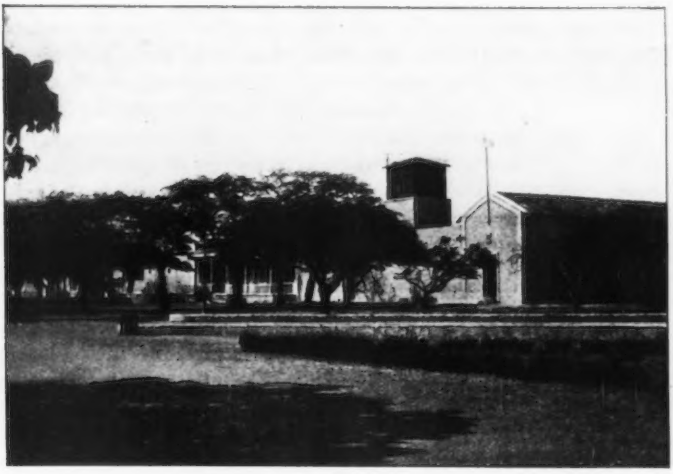
strike one at once as a remarkably fine race both physically and intellectually. However, they are so well known, and have been so often described in connection with our occupation of British Nyasaland, that it would be a work of supererogation to go into details here. I will only, therefore, touch lightly upon the habits of the particular clans with whom we met in Portuguese territory. The men are tattooed on both cheeks with three deep scars about 2 inches long midway between eye and ear; it is said that the angle at which these scars are made, denotes the particular tribe to which the man belongs. The ears are pierced in the centre, and not in the lobe as amongst the Zulus. Some article in daily use is often worn in the aperture. They construct frame-houses of oblong shape, well thatched, provided with good-sized doors, and often with windows. The larger are divided into several rooms. Sometimes a verandah extends round all four sides of the house. The dwellings are carefully plastered, and the walls often decorated with a herring-bone pattern or with figures of animals drawn in red and white. A fairly large fenced enclosure sometimes surrounds the house.

The dead are buried in sitting posture with knees drawn right up to the face, and the body is lowered into a very deep grave by means of ropes. In the case of chiefs and headmen, a very elaborate flat tombstone of plaster and clay is constructed to cover the whole surface of the grave; the modelling is frequently picked out in white. A thatched roof is placed above, and the whole surrounded by a neat reed fence. The interior of the enclosure is kept scrupulously clean and well weeded, and on the sides of the fence are hung up deceased's drinking-vessels, baskets, etc. A food dish is often placed at the side of the grave, but I never saw any weapons thus placed. These tombs are generally found in the immediate outskirts of the villages, often close alongside the footpath. The villages themselves are often of considerable size, and there is, in the more important ones, a large roofed-over space in the middle of the village, used as a public meeting-place. The spear was the national weapon of the Wayao, but in Portuguese Nyasaland the trade gun is the principal arm at the present time.

Arab influence is also seen in the long white robes and white skull-caps affected by the headmen in the villages, and by the habit adopted by the males generally of twisting a piece of cloth round the head in the fashion of a turban. Muhammedanism is the professed religion—at least, of the western tribes; but the faith of Islam seems to have no very profound effect, so far as the matter of eating and drinking is concerned, nor does it prevent the women going about their daily work in the time-honoured African fashion.

The women of some tribes wear a metal or ivory disc let into the side of the left nostril, and inserted shortly before the age of puberty, the puncture being gradually enlarged. Among other tribes the pelele is worn.

CHIEF'S GRAVE, WAYAO.



IBO POST-OFFICE.

The Maviti, once so dreaded, are no longer a force in the land. Their mantle has descended, in a manner, upon the shoulders of such men as Mataka; but it is but a poor shred of a garment now, likely soon to be blown clean away by the rude breath of advancing civilization. There is chronic fighting both with this chief and with Mntaparata, and a considerable action was fought with the latter shortly before our arrival, a little way west of the Msalu. We had glimpses of the raiders on several occasions, who seem to favour the neighbourhood of the main caravan route.

It is impossible to speak with any certainty of the number of people inhabiting the country. All report, however, is to the effect that in the north and south of the province away from European jurisdiction, and under the control of the independent chiefs, the population is very large. Our route, except in the immediate vicinity of the fortified posts, was a desert, but bore signs of having been inhabited not so many years back; this state of things prevailed until after passing Katuri's, when we came to a thickly inhabited, prosperous, and peaceful country right up to the British border.

*Resources.*—So far as could be judged in taking a mere line through the country, there is nothing to indicate the presence of precious metals or stones. No cattle were seen in the possession of the natives, and but little live stock of any kind. The tsetse fly probably accounts for this, and also for the almost entire absence of native dogs. Fat-tailed sheep and goats are kept in isolated localities. Poultry are plentiful, and form the chief animal food of the people. Towards the British border there is much more apparent prosperity, and Muscovy ducks and pigeons are not infrequently kept by the villagers. The native foodstuffs are maize, sorghum, rice (rare), beans of several kinds, sweet potatoes, and manioc (cassava). The whole country is remarkably productive in appearance, and the people, especially the Wayao of the more western districts, very well nourished. In some parts of the country, notably near the Lujenda and its tributaries, two crops of maize are raised annually, and we actually saw the grain with stalks at least 10 feet high, and carrying large cobs at the beginning of August, which must be nearly midwinter. Up to the present, there has been but little endeavour to develop agricultural resources of the country; indeed, until the truculent chiefs have been shown the advantages of a peaceful life, anything in the shape of remunerative work of this description would be impossible. Wild cotton is found locally, and is occasionally cultivated by the natives, especially west of Katuri's. I saw it growing very high up in the hills. Taking the country as a whole, there would seem to be considerable immunity from the scourge of drought. Locusts seem rare, and baboons were not seen after leaving the neighbourhood of the coast. In fact, the small seed-eating birds would appear to be the worst enemies the agriculturist has to contend with. Some of the

valleys in the Nyasa mountains, lying between 3000 and 4000 feet, were among the most fertile and the best watered I have ever seen in Africa. There the climate is fresh and bracing, and might be quite suitable for European occupation. The valleys of the Luambala and the Msalala rivers appear exceptionally fertile, increasingly so as higher elevations are reached.

Our expedition met with the greatest kindness and assistance from all the Portuguese officials of the province, who went out of their way on all occasions to make things easy and pleasant for us. Carriers were enrolled, and gaps caused by desertions filled up for us, whenever we came in to a post, with a promptitude which, considering the difficulties, was little short of marvellous.

We eventually paid off our last contingent of porters at Fort Maguire—now a heap of ruins—and, after a short visit to Mtengula, where there is a particularly neat and efficient Portuguese post, we came down by lake steamer to Fort Johnston.

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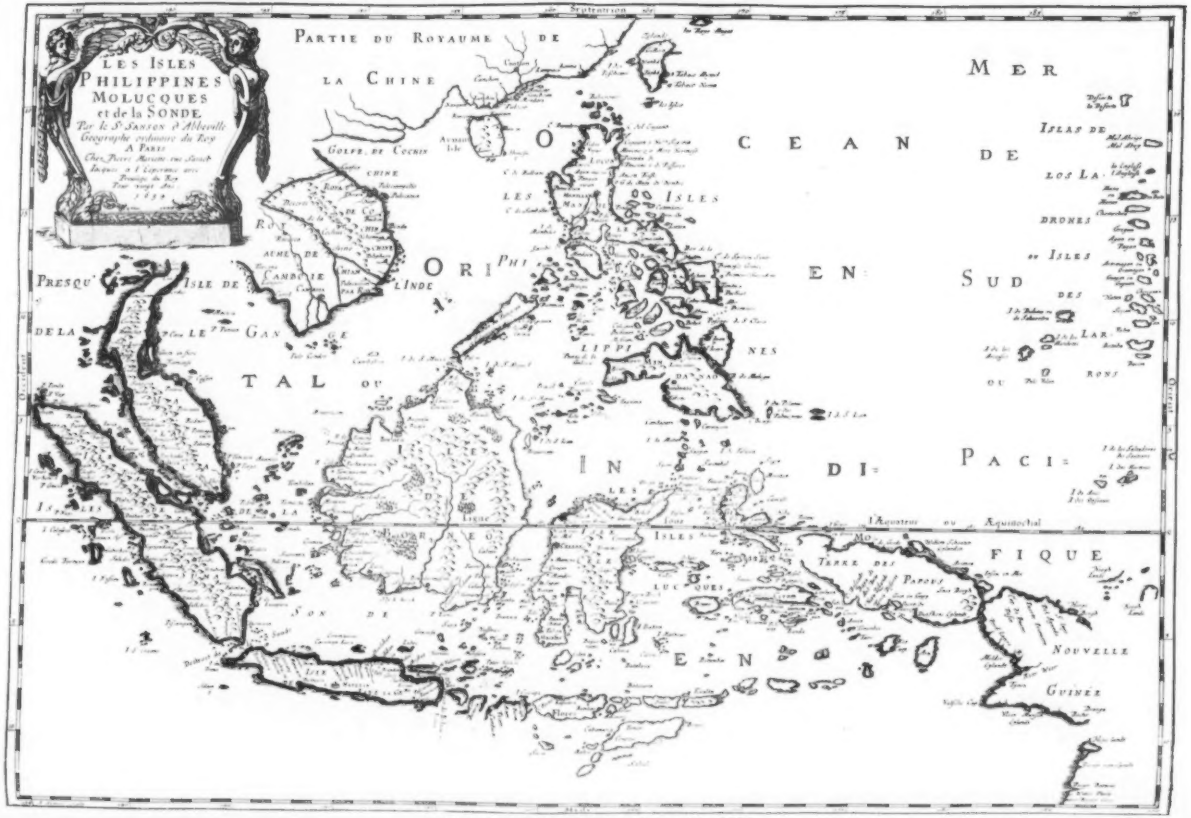
## GEOGRAPHICAL WORK IN THE PHILIPPINES.

By WARREN DU PRÉ SMITH, Ph.D., F.R.G.S., Chief of the Division of Mines, Bureau of Science, Manila.

It might be said that America entered the great Eastern game by mere chance. She came to the Philippines looking for a hostile fleet, which she put out of the way, but at the same time she found a conglomeration of alien peoples on her hands, left like a foundling on the doorstep. She took them in, and at the same time took hold of the hardest problem she has had to solve since 1861. When America began her work in the Philippines she declared that she would teach the Filipinos the art of governing themselves according to her own standard. This, I dare say, is the boldest move ever made by any nation at any time within the history of colonization. What that scheme entails, or in how far the Filipino has been taught these new ideas, is not within the province of this paper. One thing, however, is pretty clear, that America besides being the teacher has been also a learner, and I predict that when all is balanced up it will be found that America and the Americans will have received the greater benefit.

In this article I shall discuss one of the most important phases of America's work in the Philippines. It is only one phase, but it is perhaps the most important of all the material undertakings as it is the basis for so many other kinds of enterprises. It would not be just to begin with the American *régime*, omitting all the enterprising work of the Spaniards and the English.

Up to 1521 the Philippine islands remained a *terra incognita* to




MAP OF THE PHILIPPINE ISLANDS, 1654.

PHILIPPINE ISLANDS.
Progress sketch showing survey by the Coast and Geodetic Survey to Dec. 31st 1908.
Hydrography
Topography
Triangulation
Positions determined latitude & longitude (telegraphic)
Scale 1:12 000 000
Statute Miles
Formosa
LUZON
Mindoro
Panay
Samar
Negros
Bohol
MINDANAO
BORNEO
SULU ARCHIPELAGO
PALAWAN
120
125
20
15
10
5

Western peoples, although the Chinese traded here long before the coming of white men. In that year the intrepid Magellan began his long cruise around the world; he touched first Borneo, then Cebú, one of the lesser islands of the group. Magellan landed and unwisely took part in a feud then raging between the people of Cebú and the inhabitants of Mactan, and on a spot now marked by a beautiful coral monument, in a coconut grove by the sea, he met his death. His good ship *Elcano* and what was left of the valiant crew sailed away to complete the first circumnavigation of the globe, to announce to the world the death of a hero, to tell of the wonderful isles of the East.

I shall not attempt to mention all those who have done exploratory work in the Philippines, but only the most important names and works. The British Admiralty, in accordance with its policy of developing commerce, has done considerable work in these waters, particularly along the coast of Paragua island, and has published a series of general and harbour charts of the islands. One of the earliest of the British explorers in this region was William Dampier, who discovered the Batanes islands in 1687. He called them the Bashi islands, after a native drink of that name. One of the earliest works in the English language pertaining to the geography of the Philippines was 'The Indian Directory, Directions for sailing to the East Indies, China, Australia, etc.," by James Horsburgh, F.R.G.S. In the years 1843–46, Captain E. Belcher, R.N., commanded H.M.S. *Samarang* on a voyage through the Eastern seas, where important explorations were made. He visited the Philippines. In 1883 occurred the cruise of the yacht *Marchesa*. This was commanded by Lieut. R. Powell, R.N. The narrative was written by F. H. H. Guillemard, M.D. The most important contribution from this voyage was a map of Cagayan Sulu, a small island in the Sulu sea, noted for its volcanic craters and hot springs. The *Challenger*, which visited the Philippines in the latter part of the year 1874, did not do much work of a geographical nature. Most of the time was spent in making zoological collections along the shores of the islands. Another hardy Briton to touch the Philippines was one Captain Thos. Forrest, who has left a record of 'A Voyage to New Guinea and the Moluccas, etc., in the *Tartar* galley.' He was in the employ at that time of the East India Company. The voyage extended over the period from 1774–76. In this book I have found some old prints of what are probably among the earliest charts of the shores of Mindanao. In 1880 the British survey ship *Flying Fish* was still engaged in coast survey work in the vicinity of Paragua and Borneo.

Of the long procession of navigators and geographers sent out from Spain in the three hundred years of that country's dominion, the first in point of seniority is Urdaneta, who was Legaspi's navigator. It will be remembered that Legaspi founded the city of Manila in 1571. Coming now to a discussion of the Spanish work, we find a long and

most interesting story, and one that reflects very great credit upon that nation of magnificent explorers. As elsewhere, we find the missionaries in the lead. There have been in the Philippine islands, at one time or another, six great religious orders, namely, the Franciscans, the Dominicans, the Augustinians, the Recoletans, the Capuchins, and the Jesuits. Each of these bodies has contributed to the mass of valuable geographical knowledge, information which would have been much more tardy in coming forth were it not for these intrepid apostles of Christianity. Of all these perhaps the most active have been the members of that great body, the Society of Jesus, which has left its impress all over the world. For a long time we were indebted to this body for almost all the reliable

EXPLORING PARTY (BUREAU OF SCIENCE) ON THE SUMMIT OF MOUNT APO, JAN. 1907, 9610 FEET.

information regarding the mysterious and wild island of Mindanao, which had been practically under their entire control for years. When the American Government came to take an inventory of its new possessions, the Jesuits had a large collection of maps of the islands. These were turned over to the United States and published under the title 'Atlas de Filipinas.' This atlas contains thirty maps, of which eleven were executed by Enrique d'Almonte, one by Enrique Abella, one by the hydrographic commission, and three by the Jesuits. The remainder were compiled from various sources, the British Admiralty charts, etc. I am fortunate to be able to reproduce here a copy of one of the earliest maps of the Philippines. In the light of what we now

know, it is very much of a curio. This map is now in the library of the Dominican monastery in Manila.

Of all those engaged in map-making during the Spanish *régime*, D'Almonte stands out as the foremost. His maps, in most cases not based on any accurate control, are, for the character of the country traversed, the extent and execution, simply wonderful. Certainly no other one man in the Philippines, either before or since, has accomplished so much. Don Enrique D'Almonte was attached to the Mining Bureau with the title *auxiliar facultativo*, which simply means scientific assistant. He and Don Enrique Abella y Caseriego, the chief of the *Cuerpo de Ingenieros de Minas*, constantly worked together, D'Almonte as topographer, and Abella as mining engineer and geologist. Knowing, as I do, the natural difficulties of the country, the extremely savage people that exist in some parts of the islands, the very trying climatic conditions, I must regard D'Almonte as one of the great explorers of the twentieth century. I do not know if he has ever received fitting testimony of appreciation from his fellow-geographers in other parts of the world. If not, this tardy recognition should be soon forthcoming.

Before passing on to an account of French research, I must call attention to the magnetic surveys made in Mindanao by the Jesuits. One very important feature was discovered, namely, that there is a very close connection between the magnetic inclinations and the Agusan valley, one of the principal tectonic lines of the island.

I shall allude very briefly to the subject of French exploration in the Philippines for the very good reason that that nation has done very little along this line in the Philippines. The two most important contributions that I have been able to find are: First, a map entitled "Les Isles Philippines, Molucques et de la Sonde," by M. Sanson d'Abbeville, published in Paris in 1654. This is the earliest map of these islands I know of. A copy of this map is now in the archives of the Dominican monastery in Manila, and I am fortunately able to reproduce it here. The second, and probably the most important contribution, is that of Dr. J. Montano, who visited the Philippines and travelled rather extensively in the islands during the years 1879–81. Dr. Montano spent a large part of his time in Mindanao, and he with the then Governor of Davao, Rajal, made the first ascent of Mount Apó of which we have any record.

When I ascended Mount Apó in 1907, I found near the summit a clay tablet bearing the inscription—

"La Unica Expedicion á Volcan Apó
1880
Montano y Rajal."

Dr. Montano was also one of the first white men to make the entire trip from Davao up the Tagum river, over the divide, and down the long

VIEW OF THE GOLD COUNTRY OF LUZON (ANTIMOK VALLEY).

Agusan river to Surigao. He also made many very valuable anthropological, ethnological, social, and economic studies which have been published by the Department of Instruction of the French Government.

The work being done under the American *régime* is rather heterogeneous. The following bureaus and departments are at present engaged in mapping, for one purpose or another, various portions of the public domain: the United States Army; the United States Coast and Geodetic Survey; the Bureau of Constabulary; the Bureau of Lands, and the Division of Mines of the Bureau of Science. The basal work, and therefore necessarily the most accurate work of all, is that done by the Coast and Geodetic Survey. In order best to show what that organization has done, I shall include here some extracts from a memorandum which Mr. E. F. Dickins, Director of Coast Surveys, has especially prepared for me for this article. He says—

"The land area of the Philippine islands is about 115,026 square miles, and consists of over 3100 islands and islets. The water area is about five times greater in extent than the land area, and the shoals and reefs in this area of water must be carefully located and surveyed, as are the adjacent shores. About the same method of surveys as used in the United States was adopted here, only slightly modified to suit the existing conditions, and are as follows: Astronomical determinations, to furnish the latitudes and longitudes of points which are used as bases, and also azimuths to enable the charts to be correctly oriented. All these elements are determined by star observations. The triangulation furnishes a framework for the detailed survey operations, establishing the correct relative positions of the controlling points: the bases for this work are carefully measured with a steel tape. The hydrography furnishes the information regarding the water area of the charts. For the inshore work and detailed examinations of shoal and dangers a boat or launch is used, and the soundings made with a hand lead-line; for the offshore work the steamers are used, and various forms of sounding machines employed. The topography furnishes the information as to the land area of the charts, and is generally confined to the shore-line and its immediate vicinity, with the location of all prominent peaks and other landmarks that may be of service to the navigator. Tidal observations are always made in the immediate vicinity of the hydrographic work, both for use in the reduction of soundings to a common plane, and in order to make the tidal predictions which are published in our Annual Tide Tables. Magnetic observations are made in connection with every survey to determine the variation of the magnetic needle from true north, information which is placed on every chart. The Manila observatory has maintained continuous magnetic records for a number of years, but we have to obtain the data for the locality of each survey. The magnetic variation is small in the Philippines, and the line of no variation, where the needle points true north, touches the north of Luzon island.

"Active work was commenced in the Philippines in December, 1900. A sub-office was established in Manila, and two vessels were equipped for the work—the steamer *Pathfinder* by the Federal Government, and the steamer *Research* by the Insular Government. At the present time we have five steamers and one chartered launch, with a complement of 284 officers and men engaged in field work, and an office force in

BUILDING THE BENGUET ROAD, LUZON.

Manila of about 45, consisting of computers, draftsmen, and clerks. The cost of operation is borne in conjunction by the Federal and Insular Governments. The United States pays about 65 per cent. of the expenses, supplies one large steamer, all the technical force in the field, the supervising technical force in the Manila office, all the instruments and outfit, and meets the entire cost of the final revision and

publication of the charts, tide-tables, sailing directions, and other results. The Insular Government defrays about 35 per cent. of the cost of operation, furnishes four steamers and keeps them in repair, and supplies the office accommodations in Manila."

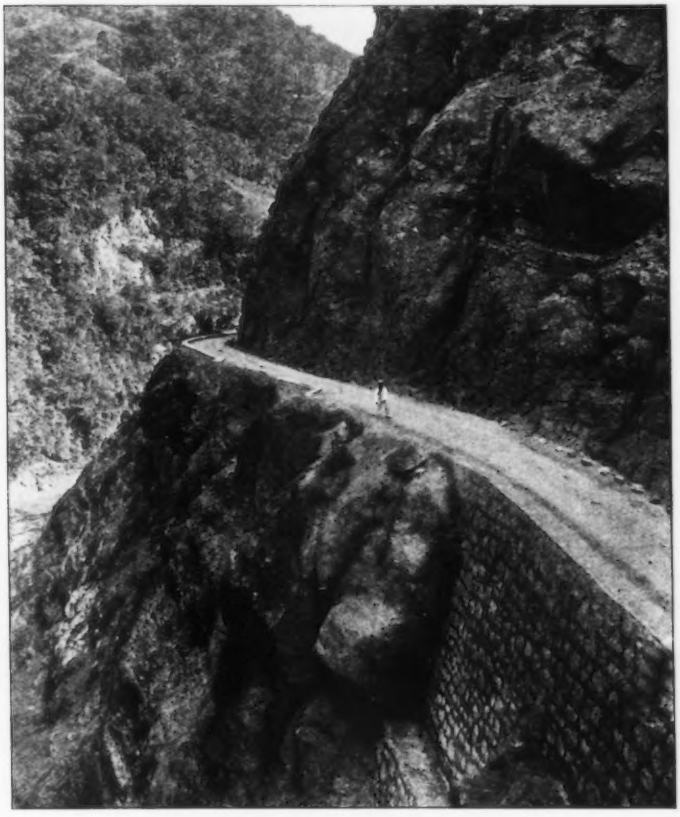
| | |
|---|---|
| The total area within boundaries of Philippine islands, taking treaty limits (approximately), square statute miles | 700,686 |
| Land area of Philippine islands, square statute miles | 115,026 |
| Total water area within boundaries, square statute miles | 585,960 |
| Total length of general coast of the Philippine islands in statute miles (approximate) | 11,511 |
| Total length of general coast-line surveyed up to June 30, 1908, in statute miles (approximate) | 3,418 |

TOTAL STATISTICS OF FIELD-WORK EXECUTED DURING THE YEAR ENDING JUNE 30, 1908.

| | |
|---|---|
| Triangulation— | |
| Square miles of area covered | 13,805 |
| Stations occupied | 285 |
| Mountain peaks determined | 143 |
| Geographical positions determined | 479 |
| Azimuth stations occupied | 3 |
| Base lines measured | 3 |
| Magnetic stations occupied | 9 |
| Topography— | |
| Square miles of area covered | 1,547 |
| Miles of detail coast-line surveyed | 1,573 |
| Number of topographic sheets completed | 54 |
| Hydrography— | |
| Square miles of area sounded | 9,614 |
| Miles of lines run while sounding | 24,454 |
| Number of soundings made | 561,415 |
| Tidal stations established | 45 |
| Number of hydrographic sheets completed | 72 |
| Number of steamers employed | 5 |
| Number of chartered launches employed | 2 |
| Number of officers and men on vessels and launches | 284 |
| Number of miles of general coast-line charted | 944 |
| Area sounded over, square miles | 9,614 |

The Bureau of Lands is obviously created for the purpose of making cadastral surveys. Besides making innumerable patent surveys for mineral and forest concessions, it has had the large task of surveying the great estates known as the Friar Lands. It may be said here that after the insurrection there arose disputes over certain great tracts of the best land in the islands. The three parties involved were the Government, the religious orders, and the natives. One of Mr. Taft's greatest achievements in the administration of the Philippines is the amicable settlement of this big question of the Friar Lands. But besides this mass of routine work, this bureau has found time to extend its functions and initiate some very important work of a much greater

scope. In this work, which I shall outline more fully below, two men have been the most active—Mr. S. O. Scudder, chief surveyor, and Mr. Chas. Benson. The latter, on the completion of a large amount of patient work in the more civilized portions of the Mountain province, pushed northward up the Agno river, mapping all the way. His party



THE BENGUET ROAD COMPLETED, LUZON.

surveyed, during portions of three years, 470 miles of rivers and trails, sketching 620 square miles of topography, and established the elevations and locations of 1739 points by the vertical angle and intersection method. This work was done at the rate of about £2 10*s.* per lineal mile of traverse, or about 38*s.* per square mile of topography. As the traverse surveys alone cost about one-half the total amount, the actual

cost of the topography was at a rate of $3.62 per square kilometre. Mr. Benson, upon his own initiative, made some experiments in photo-surveying. Owing to rain and accidents, most of the plates exposed in the one expedition on which the method was tried (Cervantes to Tegudin) were spoiled. However, enough were preserved to demonstrate that excellent results can be obtained in an open country and at a very low cost. Much of the north central Luzon country is quite open and exceedingly rugged, just the type of country most suited to this method. The Director of the Bureau of Lands, with his assistants, has elaborated a general plan which we earnestly desire to see fulfilled. It is, as follows, quoting from his memorandum: "This plan involves the putting into the field by the Coast and Geodetic Survey of a party to execute a triangulation extending south from Manila through the provinces of Rizal, Laguna, Batangas, Albay, and Sorsogon, covering the most important part of the island of Luzon from the view point of population and commercial and agricultural activity; this survey party to locate church towers or other prominent objects in each municipality within the field of operations. This plan also involves the placing of a survey party to operate in the area covered by the triangulation system of the Coast and Geodetic Survey between Manila and Dagupan, and, upon the completion of the work south of Manila, this triangulated area to be covered further in the following manner: The survey parties of the Bureau of Lands are to set two permanent monuments in the vicinity of each municipality in which a point has been located by the Coast and Geodetic system of triangulation, to determine the true azimuth and distance from the triangulation point. An accurate survey is then to be made of the streets of said municipality, and an accurate traverse line run from these monuments over the main roads connecting adjacent municipalities. This will then give an accurate skeleton map of all municipalities and main roads within the area defined."

Soon after the conclusion of hostilities (it is very difficult to say just when that occurred) the United States Army began systematic topographic mapping all over the islands. This work is of not so accurate a nature as that done by the Coast and Geodetic Survey, for two very good reasons: first, a map for military purposes does not have to be as accurate as one upon which navigation and public works depend; and, second, the men who do this class of work in the army, while they are all more or less trained men, are primarily soldiers and not professional topographers. The topographers of the army, of whom there are at present twenty-three in the Philippines, have covered an immense area throughout the islands, a large part of which is in the little-known interior of Mindanao, where it has not been altogether safe for other than a military party to operate. In this region the work of Captains Moore and Murphy deserves especial mention. Military topographic

parties are now working northward in Luzon from the vicinity of Manila. In the Visayan islands, Leyte, Cebú, and Panay, they have also been very active.

The Bureau of Constabulary, which is a sort of insular police organization, is also doing considerable map work of a very serviceable nature, though much less accurate than that done by the other organizations. This organization is made up of native soldiers officered for the most part by white men. Very frequently it is necessary for these men to go into portions of the country seldom, if ever, visited by any of the other organizations I have mentioned, and their reconnaissances are of great value, as upon them alone we must rely for any information whatever concerning certain districts.

AN IGORAT DANCE, LUZON.

The Division of Mines of the Bureau of Science is the lineal descendant of the Old Mining Bureau of Spanish days. It is the function of this organization "to make, facilitate, and encourage special studies of the mineral resources, mineral industries, and geology of the Philippine islands; to collect statistics concerning the occurrence of the economically important minerals, and the methods pursued in making their valuable constituents available for commercial use; to make collections of typical geological and mineralogical specimens, especially those of economic and commercial importance, such collections to constitute the museum of the Mining Bureau, subject, however, to transfer by executive order of the Civil Governor to any general

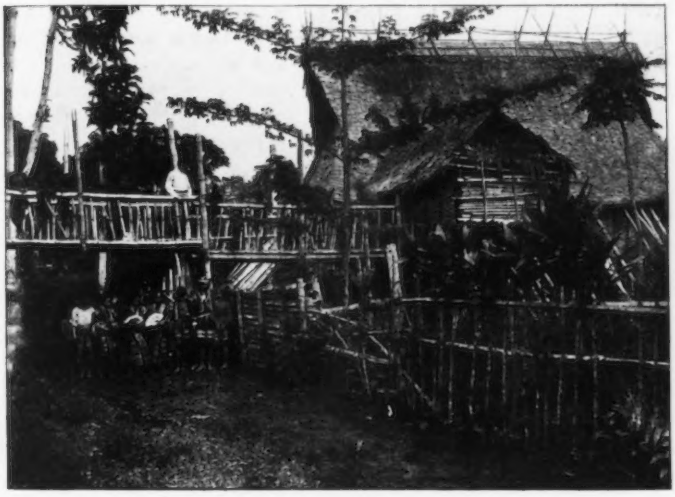
museum established; to provide a library of books, reports, drawings, etc., bearing upon the mineral industries, the sciences of mineralogy and geology, and the arts of mining and metallurgy, such library constituting the library of the Mining Bureau; to make a collection of models, drawings, and descriptions of mechanical appliances used in mining and metallurgical processes; to preserve and so maintain such collections and library as to make them available for reference and examination, and open to public inspection at reasonable hours; to maintain, in effect, a bureau of information concerning the mineral industries of the Philippine islands; to make an annual report to the Secretary of the Interior, setting forth the important results of the work of the Bureau, such special reports as may be called for by proper authority, and such bulletins concerning the statistics and technology of the mining industries and of the geological and mineralogical and other office and field work of the Bureau as may be approved by the Chief of the Bureau and ordered published by the Secretary of the Interior."

Because of the absence of accurate detail topographic maps of the mineral districts, Mr. McCaskey, the second chief of the Mining Bureau since 1898, initiated a series of surveys of three districts. He began the work himself in 1893 in the Angat iron-field, in Luzon. This was followed by maps of the Mancayan copper district by Messrs. Goodman and Ickis; the Baguio Mineral district by Mr. A. J. Eveland; the Danao-Compostela coal-field, in Cebu, by Messrs. Goodman and Ickis; the Masbate gold-fields, triangulation by Messrs. Goodman and Ickis; topography by Mr. H. G. Ferguson. The next field selected is the Paracale gold-field of Ambos Camarines, in south-eastern Luzon. These areas vary from 40 to 150 square miles, and represent the most accurate topographic work yet done anywhere in the Philippine islands. All this work is tied to points established by the Coast and Geodetic Survey, and both transit and stadia and telescopic plane-table have been used. Besides this work the various members of this staff have made longer or shorter route surveys in many portions of the islands. In the latter part of 1907, and in the early part of 1908, an expedition was made by three members from this division, consisting of the chief as geologist, Mr. Goodman as mining engineer, and Mr. Ickis as topographer, over the following route in Mindanao: Cagayan to Seville, Camp Overton to Malabang, Malabang to Cottabato, Cottabato to Davao, Davao to Butuan over the entire length of the Agusan river, and many shorter routes.

Route-maps showing topography were made wherever possible. The narrative of this expedition has already appeared in the *Philippine Journal of Science*. It is a matter of the profoundest regret that we must record here the murder of Mr. Ickis on April 1, 1908, just about at the completion of this long and arduous trip. That a man of his

sterling character, high efficiency, and loyal nature should be cut off by the ruthless hand of the savage is hard to become reconciled to. When the final history of American endeavour in these islands shall come to be written, his name should be placed high on the roll of honour. In 1906 Mr. Ickis made a route-map with geological notes across Luzon, the first time a complete section had been made.

A similar expedition to the Mindanao one is now being planned by this division for the early part of 1909 to explore the almost absolutely unknown Sierra Madre range between the Cagayan river and the eastern coast of Luzon. For this work we have been promised the co-operation of the U.S. Army. This party, it is hoped, will consist



BAGOBO HOUSE AND PEOPLE ON THE SLOPES OF MOUNT APO, MINDANAO.

of two geologists, an ethnologist, a botanist, an entomologist, and two topographers from the U.S. Army. This expedition will last five or six months, and will traverse the country occupied chiefly by the little-known tribe known as Ilongots.

So far I have referred only meagrely to botanical, ethnological, geological, etc., investigations being carried out in the Philippines. The number of travellers who have visited these shores for the purpose of study, political, ethnological, and botanical features is legion. Many like Semper, Von Drasche, Whitehead, Jagor, Blumestritt, Foreman, Worcester, etc., have made real contributions; while many others, though they have written voluminously, are to be classed rather with tourists than with serious-minded students.

The Government of the Philippine islands maintains a corps of trained scientific men known as the Bureau of Science, of which Dr. Paul C. Freer is director. This consists of divisions of ethnology, geology and mines, chemistry, and biology, in which are included sections of botany, entomology, ornithology, and fisheries. All scientific articles are published in the *Philippine Journal of Science*, which is now in its third year.

Besides the Bureau of Science, especial mention should be made of the Bureaus of Forestry and Agriculture, which are making forestry and soil maps respectively of the Public domain.

All of the scientific work is directed by the Secretary of the Interior, the Honourable Dean C. Worcester, a Fellow of the Society. It is particularly fortunate that this work is guided by a man with his reputation as a scientist, and one who has had a longer and more thorough acquaintance with the country and its peoples than any other American.

The regions still unexplored are the central portions of Mindanao lying north of the Kabakan river and between Lake Lanao and the Agusan river. Mr. Ickis was in the heart of this tract when he was killed. With him were lost all his maps, notes, and instruments. The second big unknown tract is Central Mindoro. Until recently Mount Halcon in the northern part had remained unscaled, but a party consisting of Major E. A. Mearns, U.S.A., Mr. E. D. Merrill, botanist, Bureau of Science, made the ascent. The third largest tract is in the Sierra Madre mountains in Isabella and Kagayan provinces, in the north-eastern part of Luzon; and a fourth is the territory lying between the Kagayan river and the Cordillera del Norte, also in Luzon.

I wish to make grateful acknowledgments of much assistance rendered me in the preparation of this article by my friend Mr. John T. Macleod of Manila.

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## NOTE ON THE ATOLL OF ONGTONG JAVA OR LORD HOWE'S GROUP IN THE WESTERN PACIFIC.

By C. M. WOODFORD.

As this group of islands is referred to in a paper entitled "The Western Pacific: its History and Present Condition," by Sir Everard im Thurn, read before the Society on May 10, 1909, and printed in the September number of the *Geographical Journal*, it seems to me that the present is a not inopportune moment for the publication of a note which I prepared some time ago on the origin of the name "Ongtong Java," bestowed by Tasman upon the islands sighted by him during his voyage of discovery.

The group of islands marked upon the present Admiralty chart in

lat. 5° to 5°40′ S., long. 159° to 160° E., was doubtless sighted by Mendãna in 1568. It is probably the group of islands sighted by Le Maire and Schouten on July 1, 1616, and in 1643 Tasman saw islands in

MEN AND BOYS, ONGTONG JAVA.

MEN OF ONGTONG JAVA.

or near this position. The inscription on Tasman's map of his voyage is as follows:—

"DROMMELTJENS VAN EYLANDEN
MET EEN RIF OFFTE
EYLANDEN VAN ONTHON JAVA."

The literal translation, for which I have to thank Sir Clements Markham, who kindly verified the inscription for me in 1907, appears to be—

"A small lot of islands
with one reef or the
islands of Onthon Java."

In his journal Tasman says, "We found the land to be many very small islands, about twenty, the largest not more than 2 miles long, and they all lay within one reef, about 90 miles from the coast of New Guinea. We named them Onthona Java, for the great resemblance they have with it."

As this was the first group of atoll formation that Tasman had seen in the Pacific, I suggested to Sir Clements that the islands after which Tasman had named his new discovery might be one of the atoll groups of the Indian ocean, but he subsequently ascertained for me through a Dutch correspondent, who replied to his inquiry as follows: "It is clear that Tasman meant the islands to the north-west of Batavia, one of which, now Amsterdam, used to be called in pre-European times, 'Oentoeng Java.' Oenteng means 'profit,' 'advantage,' 'happiness,' both in Malay and Javanese. Still existing is 'Ontong Djawa Point,' just to the south of the island."

Whether the islands seen by Tasman were the group of islands to which the name "Ongtong Java" is attached in modern charts, or whether they were the islands comprising the small atoll group of Nukumanu about 40 miles to the northward, named the Tasman group in recent charts, it is perhaps impossible to determine with certainty, but on Tasman's map the islands seen by him are placed in about 4° 30′ S., a position which agrees better with the atoll of Nukumanu.

The Nukumanu atoll consists of about twenty small islands, all situated upon one reef of a horseshoe shape, and with an entrance from the westward. This agrees well with Tasman's description, and upon the whole I am of opinion that the name "Ongtong Java," as at present applied to the more southern and larger atoll, is a misnomer.

The name of Lord Howe's group, by which the atoll is perhaps more familiarly known to Englishmen, was apparently bestowed upon it by Admiral Hunter, during his voyage from Port Jackson to Batavia in 1791, after the loss of the *Sirius*. It must not be confounded with the Lord Howe's island situated off the east coast of Australia. The

WOMEN OF ONGTONG JAVA.

GRAVES AT ONGTONG JAVA.

(The large monolith marks the grave of the late chief Ouila, and is about 12 feet in height.)

natives have no name for the atoll as a whole, but each island, of which there are perhaps forty or fifty, has its own name. The principal settlements are upon the island of Luaniua, situated at the eastern end and upon the island of Pelau, near the western fringe of the atoll. I had the honour of hoisting the flag and declaring the British Protectorate over the group in 1900. Thirteen of the principal islands were mentioned by name in the proclamation, which also included all the other islands situated within or upon the reef. I have visited the group three times since.

At the same time I hoisted the flag on the smaller atoll of Nukumanu, regarding it as an appendage of the larger atoll, but it had subsequently to be removed, and the line of demarcation of the British and German possessions now passes between the two.

The larger and more southern atoll, to which I shall now refer as Lord Howe's group, is of reniform shape, and measures about 40 to 50 miles in its greater diameter. It is certainly the largest atoll in the Pacific, and probably in the world. The natives are Polynesians, with a strong Micronesian admixture. Traditions of canoes having arrived with castaways from at least five islands in the Gilbert group are preserved. Canoes from Sikaiana, or Stewart's island, have occasionally visited the group and returned to Sikaiana. During one visit I noticed a pure Kanaka* from the Hawaiian islands at Pelau, probably left there by a whaler. I also noticed one case of albinism. The cross-weaving loom is in use for making mats. Specimens have been deposited by me in the British Museum. Both men and women are tattooed in curious and intricate patterns. The principal *motif* is a fish, and indicates a connection with the tattooing of Sikaiana. An illustration of male tattooing from my drawings was published by the Royal Anthropological Institute in *Man*, September, 1906, but I have been twice unsuccessful in an attempt to secure a drawing of the female design.

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* On the Derivation of the Term "Kanaka."—In the discussion following the paper on the Western Pacific above referred to, the etymology of the word Kanaka was discussed. This is correctly given in the best dictionaries as the Hawaiian word for "man," and must have been in common use as applied to natives of that group on board whaling vessels for at least seventy years, but I have not found an earlier reference than 1840.

During the middle of the last century many thousands of the natives of the Hawaiian islands went to sea in whalers, and were known as Kanakas, but no one would have then thought of applying the term to a Melanesian of the Solomon islands or New Hebrides, any more than to an African negro. I remember a case in my own experience about twenty-five years ago, when two natives of the Hawaiian islands were pointed out to me on board a trading vessel, and specially indicated as Kanakas, as distinguished from the other members of the native crew, some of which were Fijians, and some Solomon islanders. How the word came to be associated with the Melanesian natives who were recruited for Queensland from the Solomon islands and New Hebrides I cannot explain, except that it appears to be the rule in the labour trade to call things by wrong names. In the Fiji labour trade they are just as incorrectly described as Polynesians.

Herr Parkinson was more fortunate, and gives excellent representations of both male and female tattooing on pp. 532 and 533 of his most valuable book, 'Dreizig Jahre in der Südsee' (Stuttgart), 1907.*

## DESIDERATA IN TIDAL OBSERVATIONS.

When recently in England, Mr. O. H. Tittman, Superintendent of the United States Coast and Geodetic Survey, handed to Sir George Darwin the accompanying memorandum by Mr. Rollin Harris. As Sir George Darwin agrees with Mr. Tittmann that it would be advantageous that the memorandum should be given as wide a publicity as possible, he offers it for publication in the *Geographical Journal*, as follows:—

"I wish to submit the following list of points and localities where tidal observations, even if continued for only a few days at a station, would be of great value in the general theory of ocean tides:—

"1. The coast of the Antarctic continent south of southern Africa.

"The time of the tide is nearly simultaneous from Madagascar to Tristan da Cunha, and the average rise and fall amount to about 5 feet. Now, it is important to know whether the high water upon the Antarctic continent, say between long. 60° E. and 30° W., occurs at nearly the time when it is low water at Cape of Good Hope and Tristan da Cunha.

"2. The coast of the Antarctic continent in longitude about 80° E.

"3. The coast of the Antarctic continent south of Australia.

"4. Islands south of southern Africa.

"5. Easter island. The published establishments for this island are $2^h\ 0^m$, $0^h\ 39^m$, $5^h\ 55^m$; and there is no means at hand for telling which is the correct value.

"6. Islands lying between Easter island and Chile.

"7. Pitcairn island and small neighbouring islands.

"8. Hervey or Cook islands. These are near a no-tide point, and would be useful in fixing its position.

"9. Dougherty and Nimrod islands, southern Pacific.

"10. Macquarie island and Bounty and Antipodes islands

"11. Western coast of Graham Land.

"12. James bay and eastern coast of Hudson bay.

"13. Northern coast of Siberia and off-lying islands. here appear to be no tidal observations along the coast between long. 175° W. and 85° E.

"14. Southern and eastern coast of the Gulf of Carpentaria, Australia.

* The four accompanying photographs were taken by Mr. F. J. Barnett, of the Protectorate Government Service.

"15. Caribbean coast of Colombia and Venezuela from the Gulf of Darien to Caracas.

"16. Isle of Pines and vicinity.

"ROLLIN A. HARRIS,
"Of the U.S. Coast and Geodetic Survey."

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## GEOGRAPHY AT THE BRITISH ASSOCIATION.

By GEO. G. CHISHOLM, M.A., B.Sc.

FOR the third time the British Association met this year in that part of the British empire in favour of which the practice of meeting within the United Kingdom was first departed from. The first of the three meetings referred to was that held at Montreal in 1884; the second was the Toronto meeting in 1897; and this year the meeting was held at Winnipeg, under the presidency of Sir J. J. Thomson. Of these three the Montreal meeting was the most numerously attended, which is no more than might have been expected in view of the greater populousness of the city and neighbourhood, and the easy accessibility of the city from Europe and the most populous parts of the United States. The very successful Winnipeg meeting, however, comes second in point of attendance. The tickets issued at the three meetings numbered respectively 1777, 1362, and 1420.

As the writer of the present notice passed through Winnipeg exactly six years ago, it may be worth while to mention, before passing on to the immediate subject of the notice, that he found the evidences of rapid and solid advance in the interval very striking. Already in 1903 the sense of the prairie, with limitless room for expansion in all directions, was marked by the spaciousness of the town plan. Nearly all the streets are unusually wide, and most of them provided with strips of grass of about 15 feet in width between the carriage way and the side walks on either hand. In 1903, however, the paving was in many cases primitive, while now it is for the most part excellent. Meantime many large new buildings, solidly built in stone or brick, have been erected in large numbers, older buildings have been raised in height and otherwise extended, and new and beautiful residential quarters have been added to the town.

Section E met this year under the presidency of Colonel Sir Duncan A. Johnston, K.C.M.G., formerly Director-General of the Ordnance Survey of the United Kingdom. The vice-presidents were Colonel Bigg-Wither, F.R.A.S., and Dr. Tempest Anderson; and the other members of the committee were Mr. C. N. Bell (Winnipeg), Dr. Robert Bell (Ottawa), Prof. A. P. Brigham (Hamilton, N.Y.), Prof. Dodge (Columbia College, New York), Prof. J. Stanley Gardiner, F.R.S., Sir Charles Watson; and the secretaries, Mr. A. McIntyre, B.A., Vice-Principal, Normal School, Winnipeg (hon. local secretary), Mr. McFarlane (Manchester), and Mr. G. G. Chisholm (recorder). The section was well housed in Manitoba College.

The programme of the section was both full and interesting. Besides the president's address, twenty-two papers were offered to and accepted by the committee, but two of these were read in joint meetings with other sections, to which papers on cognate subjects had been offered.

The first paper read after the president's address on Thursday, August 26, was one by Miss Luella A. Owen, of St. Joseph, Missouri, on "Floods in the Great Interior Valley of North America." Briefly reviewing the floods that have made records in the valley within the past sixty-five years, notably the three greatest

of that period, those of 1844, 1881, and 1903, the author pointed out that the floods are very variable in evidence both in respect of the period of the year at which they occur and the precise locality of maximum flood, and as this latter circumstance is due to the fact that the chief cause of floods is excess of local rains, the author drew the inference that no perceptible degree of relief could be effected by the remedy which has received much public approval—the construction of storage reservoirs on the headwaters of the Missouri. Mr. James White, head of the Geographical Department, Ottawa, then read a paper on "The Nomenclature of the Arctic Islands and Lands of the Dominion of Canada," a paper which it is impossible to give in abstract, but containing a multitude of interesting particulars, which it is hoped readers of the *Journal* may find in full in some future issue. The third paper read this morning was one by Dr. Robert Bell, formerly Director of the Geological Survey of the Dominion of Canada, on "The Hudson Bay Route in its Present Aspect," the author insisting, as he has so often done before, on the feasibility and importance of this route, and laying special stress on the advantages which it is likely to have on the development of British trade with the north-west of Canada.

In the afternoon there was a joint meeting of Section E with sub-section K (Agriculture), held in the room of the latter, at which two important papers were read; the first, prepared for Section E by Prof. A. P. Brigham, secretary to the American Association of Geographers on "The Development of Wheat Culture in North America;" and the other by Prof. Mavor, Toronto, prepared for the sub-section on Agriculture, on the "Agricultural Development of Canada, 1904 to 1909." As it is expected that Prof. Brigham's paper will ultimately appear in full in the *Journal*, it is enough to mention here that the author takes a sanguine view of the future of wheat culture on the continent. Prof. Mavor's paper, which was read in the author's absence by Dr. Russell, the recorder of the section, was a continuation of his well-known report to the Board of Trade on the same subject, a report coming down to the year 1904. In the paper now presented to the British Association, Prof. Mavor again endeavoured to moderate what he considers the over-sanguine estimates formed by some of the possibilities of wheat-cultivation in the Canadian North-West, but conceded that in his former report he had under-estimated those possibilities perhaps by as much as 25 per cent. The reading of the two papers was followed by an interesting discussion, in which Prof. Chapman, President of Section F, Major Craigie, Chairman of Sub-section K, Dr. William Saunders, Director of the Dominion Experimental Farms, Dr. Robertson, Head of the Macdonald Institute, Montreal, and others took part.

The first paper read in Section E on Friday, August 27, was another by Prof. Mavor on "The Economic Geography of Canada," which was read by the recorder. The main thesis of this paper was that, owing to the character of the contours of Canada, the rivers could serve only to a limited extent as a means to the development of the territory of the Dominion, and that consequently the greater part of that territory had to wait for railway development as a means of rapid settlement. Mr. J. Stanley Gardiner then gave a more or less popular account of the Seychelles as the result of his study of that group as secretary of the committee appointed by the Association for the investigation of the Indian ocean. The lecture was illustrated by a large number of beautiful lantern-slides, by means of which many interesting points in the structure of the island and the local influences on the peculiarities of the vegetation were indicated. Mentioning that when the Seychelles were ceded by the French to Great Britain, it was stipulated that the French language and French law should be maintained for a hundred years after, Mr. Gardiner pointed out that this period was now about to expire, and that accordingly

Great Britain would then have a freer hand in dealing with the group, so that he anticipated that, partly in consequence of their situation, partly in consequence of the admirable harbourage they afforded, perfectly secure and amply sufficient for the whole British navy, the islands would acquire in the near future a high degree of strategic importance. The next paper, by Prof. Hobbs, of Michigan University, Ann Arbor, presented a novel theory with reference to a Cycle of Alpine Glaciation, but as this paper will be published in a subsequent number of the *Journal*, it will be enough to refer readers to the complete paper with its necessary illustrations. Prof. Dodge, of Columbia College, New York, then followed with a short paper on "The Formation of Arroyos in Adobe-filled Valleys in the South-Western United States," in which it was pointed out that those arroyos, which now cut into gently sloping, grass-covered flats, are evidently of recent origin, and evidence is given for the view (held by the natives) that their formation is connected with the introduction of sheep by the white man. Formerly the water ran off those flats in sheets, but the sheep-paths gave the water an opportunity to become concentrated in streams. The last paper read that morning was one by Mr. Lawrence J. Burpee, of the Carnegie Library, Ottawa, on "Water Routes from Lake Superior to the Westward."

Saturday was, as usual, entirely devoted to excursions; and on Monday, August 30, the work of the section opened with a joint meeting with Section H on the teaching of geography in secondary schools. Two papers on this subject were read, one by Prof. Dodge, and the other by Dr. C. H. Leete, Principal of the Sachs School for Girls, New York, who had had more than a quarter of a century's experience in this work. The latter paper, in the absence of the author, was read by the recorder of Section E. The reading of these papers was followed by a discussion, in which Prof. Johnson (Harvard), Prof. Brigham (Hamilton, New York), Mr. Hugh Richardson (science master in Bootham School, York), Dr. C. W. Kimmins, Miss Baber (head of the School of Education, Chicago University), and the recorder of Section E took part. Perhaps the most interesting feature of the discussion was the nearly unanimous expression of opinion on the part of those who took part in it, even those who represented primarily the physical side of geography, that in the teaching of physical geography every opportunity should be taken to indicate and emphasize the influence directly or indirectly exercised on man by the processes which are made the subject of study in physical geography. This discussion being concluded, a large audience (the largest during the whole meeting) gathered to hear a lecture by Mr. Arthur O. Wheeler, President of the Alpine Club, on "Some Characteristics of the Canadian Rockies," a circumstance largely due to the peculiar interest excited in this subject by the "western excursion," to which further reference is made at the end of this article.

Five papers were read on the morning of Tuesday, August 31. Mr. George E. Hooker, Civic Secretary to the City Club of Chicago, began with an interesting and elaborate paper on "The Relation of Local Mechanical Transportation to the Structure of Modern Cities," the main thesis of which was that the time had now come when the organization of cities, in recognition of mechanical transport as their basic factor, should be definitely undertaken, and that with a view to that there should be unified systems of freight and passage-lines, all if possible in the open air, with cross-city connecting lines in directions at right angles to one another. Prof. A. P. Coleman, of Toronto, followed with a paper on "The Yellowhead Pass and Mount Robson," the highest peak in the Canadian Rockies, which will offer the most striking scenery in the Grand Trunk Pacific route to the coast. In the course of the paper, which was beautifully illustrated by coloured lantern-slides, the author described two ineffectual attempts to reach the summit of the mountain. Prof. J. W. Gregory, of Glasgow, then gave an account of the remarkable and unexpected

results of the replacement of Kanaka by white labour in the tropical sugar plantations of Australia. This experiment has proved in every way satisfactory. The production of sugar has been fully maintained in amount. The white labour has proved to be not only more efficient, but more economic. The rate of mortality is less in the case of the white labourers than it was in that of the coloured, and the inspectors of schools report that the children of these white labourers are quite as efficient as those of the southern parts of Queensland outside of the tropics. The next two papers were on cognate subjects. One, by Prof. J. W. Johnson, of Harvard University, showed, with the aid of a series of diagrams, how wave and current-action explained the present form of Nantasket beach, a spit running northwards on the east side of Massachusetts bay; the other, by Dr. F. P. Gulliver, secretary to the Geological and Geographical section of the American Association for the Advancement of Science, described and explained, with the aid of lantern-slides, the opening by a storm and the subsequent closing of a channel navigable for small boats through what he called a tombolo in Nautucket island, this term (an Italian word meaning "a pillow") being suggested by its use in Italy as the name of the rocks connecting Mount Argentario with the mainland.

On Wednesday, September 1, the last day of the meeting, Mr. James White, of Ottawa, began with two papers on Canada, one illustrated by a series of maps showing the progress of our knowledge of Canada from 1497 to the present day, the other mainly made up of a number of statistical diagrams illustrating the economic development of the Dominion of Canada from 1867 to 1909. The first of these two papers will be published in full in the pages of this *Journal*, where also will appear the next paper, read by Mr. J. B. Tyrrell, formerly geologist of the Geological Survey of Canada, giving an account of the remarkable career of David Thompson, the pioneer surveyor of Western Canada, whom the author of the paper designates as "the greatest practical land geographer who has ever lived." Dr. L. A. Bauer, director of the department of terrestrial magnetism at the Carnegie Institution, Washington, then gave an account of the work done to the present time by that department. By way of indicating the importance of that work, it may be mentioned that in the Pacific ocean the cruises of the *Galilee* between July, 1905, and June, 1908, amounting in all to 60,000 nautical miles, discovered errors of serious consequence to mariners as well as to the scientific investigator. For example, on the great circle route from Seattle to Yokohama, the error of the charts in magnetic declination about the middle of the route, off the Aleutian isles, was found to reach 3° or more. On the San Francisco-Honolulu route, the charts were found to be from 1° to 2° out, always in the same direction. The lines of magnetic dip as given on the present charts were 1° to 3° wrong in various parts of the Pacific, and the lines of equal horizontal force were found to be in error by about $\frac{1}{25}$ part. The last paper read to the section was one by Mr. M. Allorge, of the Oxford School of Geography, giving an account of the main structural and morphological features of the eastern (Tunisian) Atlas. The most interesting point in the paper was the illustration it afforded of the influence of differences in the amount of rainfall on different sides of mountains on the displacement of watersheds.

Of the Saturday excursions, that which appears to have been the most largely attended was that to Portage La Prairie, which gave those who took part in it the opportunity, not only of seeing some of the most extensive wheatfields in the neighbourhood of Winnipeg, but also the methods of handling and milling the wheat.

It would be wrong to conclude without acknowledging how far the success of the meeting was promoted by the cordiality and hospitality with which the Association was received by the Dominion Government, the city and people of Winnipeg, and the provincial governments and cities of the West. At the close of

the meeting, all the officials and the ladies accompanying them, besides a number of other invited guests, a party amounting in all to about two hundred, were taken in a luxurious special train on an excursion to Victoria, B.C., returning to Winnipeg by way of Edmonton and the line of the Canadian Northern Railway. At every stopping-place on this route all that could be done was done by the people to show the heartiness with which the visit of the Association to Canada was welcomed.

## THE TONGARIRO NATIONAL PARK OF NEW ZEALAND.

Much interesting matter is afforded by the publication of a finely illustrated 'Report* on a Botanical Survey of the Tongariro National Park of New Zealand,' by Dr. L. Cockayne. The special reserve situated in the interior of the north island, and known as the Tongariro National Park, contains much fine and varied scenery due in large measure to high and extensive ranges of volcanic mountains. With the adjacent country, it consists of a central chain of mountains running north-east and rising from a plateau 3000 feet high. On the east this high plain is about 6 miles wide and bounded by the Kaimanawa mountains; on the west and south it merges into the broken, forest-clad country watered by the Wanganui and tributaries. The general surface features of the park are the outcome of frost and steam action upon volcanic structures. The volcano of Ruapehu, 9200 feet above the sea, is remarkable for the presence of a hot lake near the eastern side of a great crater a mile across, and filled with ice, occupying the summit of the mountain. The lake fills a small subsidiary crater in which at present all the volcanic activity of the mountain seems to be concentrated; it is depressed about 150 feet beneath the level of the surrounding ice, is roughly circular in shape, and about 200 yards in diameter. From the ice-cliffs which overhang the lake small icebergs are constantly breaking away, but they are, of course, soon melted. The lake frequently boils, and on March 22, 1906, ejected quantities of mud on the surrounding snow. It is more usually quiet, however, but has a strong sulphurous smell and a dirty colour. The origin of the lake appears to be the melting of ice by steam issuing from a crack or fissure in the mountain. The probability, also, is that the water of the lake, percolating through the porous scoriaceous rocks on the eastern side, forms the true source of the Wangaehu river flowing southward into Cook strait. Ruapehu is, moreover, of peculiar interest from the fact of its possessing, with Mount Egmont, the only glaciers in the north island; small glaciers hang in the hollows on the eastern, southern, and western slopes of the mountain, but they cannot compare in beauty and magnitude with the ice-rivers of the south island. Ruapehu itself is a great cone rising from the central plateau, and, being built up of successive flows of andesitic lava and showers of scoria, exhibits a characteristically beautiful profile. The sides have been deeply scored by mountain torrents originating in the upper glaciers and snow-fields, and the lower slopes are distinguished by a large amount of disintegrated matter, through which here and there the solid rock, generally of a dark colour, protrudes in weird and fantastic forms. The exposed lavas of the upper part of the cone are sometimes black with a resinous surface, and sometimes red, containing prominent hornblendes, but are usually of varying shades of grey. The volcano of Tongariro is noteworthy for explosive ejections of steam and sulphurous gases from some of its craters.

Many of the distinctive features of the scenery of the park, however, are due

* New Zealand, Department of Lands, C–11. 1908.

to the vegetation, which, as elsewhere in New Zealand, is of a unique character. The plants of a locality not being arranged fortuitously, but in definite combinations termed technically plant-formations, it becomes one of the first objects of a botanical survey to map out and describe such formations as having important bearings upon agriculture and horticulture, and in the case of a scenic reserve like the Tongariro park, the procedure is necessary in considering the main factors which determine the scenery. The lowest altitudinal limit of the park is about 3000 feet, and even as low as this the vegetation may be considered *sub-alpine*. There are, nevertheless, large forest-masses to the south and west of Ruapehu and small collections of trees occupying deep gullies on the east of the volcanic plateau, where mild enough conditions, characterized especially by absence of wind, prevail to render the formations more of a *montane* nature. The two main classes of vegetation may be styled "forest" and "steppe," and these are connected by the sub-alpine scrub; at the same time there are large areas with an easily recognized and uniform vegetation each possessing its own peculiar features. The dominant trees of the forests are various species of *Nothofagus*, a kind of beech. All the beech forests bear close relationship, but the general appearance is distinct according as one or other species prevails. Thus the close dark-coloured foliage arranged in layers of the mountain beech, *Nothofagus cliffortioides*, is very distinct from the bright green and more open foliage of *N. fusca*. In one part of the park is a forest composed mainly of the thin-leaved Totara (*Podo-carpus Hallii*), the beeches being entirely absent. The forest formations are, however, much smaller in extent than the desert, steppe, and scrub formations which cover the larger part of the park. To describe in detail the wealth of vegetation (260 species of plants altogether) found in the Tongariro reserve would profit the botanical specialist only, but among other plant features of the landscape may be noted the brown steppe of waving tussock, the reddish carpet of shrubs clothing the barren slopes, and the snow-white gentian blossoms (*Gentiana bellidifolia*), together with the silvery cushions of a moss-like seed-plant which enliven the gloomy wind-swept scoria deserts like Onetapu. The Park is rich in bird and insect-life. The cry of the cicada is heard all day long in the beech forests and scrubs, and the mutton-bird ("titi" of the Maoris) uttering strange cries at night is very common. Of introduced animals hares are very abundant, whilst herds of wild horses and cattle owned by natives roam at large and pasture on the grass steppes. Few statistics are available concerning the climate of the volcanic plateau constituting the park, and these refer only to rainfall. The distribution of vegetation points to much heavier rainfall on the west and south of the volcanic chain than on the east, and the rainfall statistics bear this out. Thus in 1907, at Makatote, rain fell to the depth of 99·26 inches during 231 days, but at Taupo it rained only on 112 days to the depth of 60·05 inches. Between 3000 and 4000 feet snow does not apparently lie for more than a few days, except where it has drifted. This shows how much warmer the climate of New Zealand is than the otherwise not very dissimilar climate of England, where even at sea-level snow commonly lies for many days and occasionally weeks in succession. Above 4000 feet in the Tongariro park the snow lies throughout the winter, whilst on Ruapehu there are, as aforesaid, perpetual snow-fields. Frost is very common on the volcanic plateau, and even on January nights ice may form fairly thickly on shallow water. It would seem, however, that the temperature rarely falls at any time of the year below 15° Fahr. There, as elsewhere in New Zealand, high winds are prevalent. It were natural that such a wild and grand region as the Tongariro park should be the centre of strange legends and superstitious beliefs. "The volcanoes and volcanic plateau," to conclude with the words of Dr. Cockayne, "with their steaming mountains, dread sounds issuing from the Earth itself, fearsome lakes in crater hollows,

moving deserts of sand, and strange stone-figures rising from the black and glistening lava-flows, could not fail to be invested with many curious stories, and be, to the Maori, places which should be approached with the utmost caution or altogether shunned."

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## DR. LONGSTAFF'S HIMALAYAN EXPEDITION.

THE *Times of India* of September 2 contains a long and detailed account of the first portion of Dr. Longstaff's latest expedition by Dr. Arthur Neve, one of the members of the expedition. Dr. Neve points out that up to this year no expedition had crossed the main axis of elevation of the Mustagh and Karakoram range between the Mustagh pass on the west and the bridle path over the Karakoram range on the east, a distance of 90 miles, within which not a single pass was known. Sir Francis Younghusband, while exploring the upper valley of the Yarkand river, had discovered the western Aghil range, between which and the Mustagh lay the Oprang valley, with its great glaciers from the northern slopes of Gasherbrum and $K_2$; but though he had penetrated to the head of the valley, and found a saddle-shaped depression, he had been obliged to turn back without elucidating the problem of the passes leading into Kashmir. On Dr. Longstaff's arrival at Srinagar this year Sir Francis Younghusband placed at his disposal the detailed notes of the survey of the Oprang valley. An examination of these, Dr. Neve says, showed that the cartographers had taken considerable liberties with the observations in order to fit them in with the preconceived ideas of the Survey department. An interesting clue for the fixing of the peaks sighted by Sir Francis Younghusband was furnished by the Duke of the Abruzzi, who in conversation with Sir Francis pointed out the extraordinary similarity in outline between a sketch of Gasherbrum drawn by A. D. McCormick from the south and the sketch of a peak drawn by Sir Francis Younghusband from the north. On the assumption that this suggested identification is correct, the saddle and pass seen by Sir Francis Younghusband lie to the north-west of the position hitherto assigned to them, and there is—or was before Dr. Longstaff's expedition—left on the map a blank space representing a considerable area north of lat. 35° 30′ N., in the neighbourhood of long. 77° E.

The expedition left Srinagar at the end of May. It included, besides Dr. Longstaff and Dr. Neve, Lieut. A. M. Slingsby of the Frontier Force. Khapalu was reached by way of the Zogi and Gantse passes, though locally the latter pass was not supposed to be open until much later in the season. From Khapalu the expedition crossed the Shayok river into the Hushe valley, whence a low pass led into the Saltoro valley. The scenery shows upon the grandest scale, says Dr. Neve, the typical conditions of Baltistan. The river-bed is wide and sandy, shut in by cliffs, and at the opening of each side ravine there is a fan-shaped talus richly cultivated and terraced, well irrigated, and bearing crops of wheat and barley almost hidden by dense masses of apricot trees, with here and there walnuts or poplars. The huts are of stone, clustered thickly on any stony knoll or old moraine. Some of the huts have a light upper story of lath and plaster for summer use. Towering about the huts rise gigantic walls of granite to peaks 21,000 feet high, presenting the steepest and smoothest precipice-faces Dr. Neve has ever seen.

The final arrangements for the exploration of the Saltoro or Bilaphond glacier were made at Guma, in the upper Saltoro valley. Starting up the Bilaphond valley, the explorers soon came in sight of the great main glacier, and established a base camp in a lovely grassy glade, among willow trees and rose bushes, with some

big rocks and caves in which the porters found ample accommodation. The Balti porters knew the place well, as it is a favourite grazing-ground, and they informed the explorers that during the last twenty years or so the glacier had advanced about a quarter of a mile. During a reconnoitring expedition on the following day a view was obtained of a lofty snow-peak, almost due east, which was identified as $K_{12}$; but there was considerable doubt about the identification of this and all other peaks, as the explorers had reached a point where the maps were quite unreliable. Ascending the glacier, the expedition encamped at a height of about 17,000 feet, near to some ancient stone-shelters, of which even the Baltis were without knowledge. The shelters were roofless, and in their best days could not have been more than about 4 feet high, but they indicated that the pass was known and used in former days. Early next morning the explorers continued up the easy snow-slopes which led due north to a wide saddle some 1500 feet above the camp. They reached the top in three hours, and there they found themselves on a snow-plateau of great extent, sloping up west to the outlying peaks of $K_{10}$, and east up a shallow valley to the snow-ridge going north from $K_{12}$. In front, perhaps 15 miles to the north, was a lofty, dazzling snowy range, evidently the Aghils. Progress across the plateau was delayed by the soft condition of the snow, and Dr. Neve says that great credit is due to the porters, who neither grumbled nor despaired. After a night on the snow-field, the journey was continued to the very large glacier in front. Dr. Neve says that he has seen the Hispar glacier and the Chogo Lungma, but none which has made on him such an impression of size as the one that then lay before them. According to the Baltis, the country to the north is called Terim, and that name was therefore given to the glacier. It appeared to originate near Gasherbrum peak, which could be seen some 25 miles to the north-west; and in the same direction, only a little more to the right, was a depression which appeared to correspond with the saddle seen by Sir Francis Younghusband; over it a pass could probably be made to the Oprang valley.

Dr. Neve reports that the Terim valley is evidently tectonic, with granite to the south and limestone and slate to the north. Its upper part averages 4 miles in width between the spurs. In its size and stratigraphical relations it is analogous to the valley of the Baltoro glacier on the Indian side of the watershed. Lessening supplies and the fear that the pass would become blocked with snow obliged the explorers to retrace their steps without following the glacier to its termination, and when, after the return to the expedition's base, Dr. Longstaff came to work out his map, it was realized that further exploration would be necessary to settle the question of the connections of the Terim glacier. Does the Terim, asks Dr. Neve, belong to Chinese Turkestan or to British India? When on the glacier, the explorers had assumed that it must flow to join the Yarkand river, of which it would undoubtedly be the longest and largest tributary. But when the map was worked out, the question arose whether the glacier might not turn south and flow down to the upper Nubra.

It was to find the answer to this question that Dr. Longstaff afterwards proceeded to Nubra. A telegram has been received from Dr. Longstaff from Leh, stating that he has connected the Terim* with the Saichar glacier, at the head of the Nubra valley, making it 50 miles long. It would seem, therefore, that the Terim lies on the Indian side of the watershed.

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* In view of Dr. Neve's article, it is obvious that Dr. Longstaff's telegram has no reference to the Tarim, or lower Yarkand, river of Chinese Turkestan.

# REVIEWS.

## ASIA.

### Two Indian Tribes.

'The Mikirs.' From the papers of the late Edward Stack, edited, arranged, and supplemented by Sir Charles Lyall. London: Nutt. 1908. 8½ × 5½ inches. Pp. xvii. + 183. *Price 7s. 6d.*

'The Meitheis.' By T. C. Hodson. Pp. xvii. + 227. *Same publisher, size, and price.*

At a time when it is becoming more and more recognized that a training in anthropology must be given to those whose duties, whether administrative or commercial, will take them among the native races of the world, the appearance of this admirable series of monographs is especially welcome. It is now many years since the Government Press at Shillong started to issue grammars, vocabularies, and other works dealing with the peoples inhabiting the eastern part of the Indian Empire. But with this series the Government has broken new ground. The fault of the earlier publications was that they were too official, if that be a fault. They were issued in the familiar blue paper covers, and the typography often left much to be desired. But this new series has nothing of the blue book about it, and is admirably printed and well got up. Moreover, the earlier series was almost entirely linguistic, whereas this is of general ethnological interest, and although chapters on the language and grammar are very rightly included, these are subservient to the rest of the work. In addition the books contain a number of illustrations, some in colour, and of these those by a native artist in Mr. Hodson's monograph call for especial mention.

It is impossible in this notice to do more than summarize the contents of each work, especially as there is nothing of an especially geographical nature in either. Each book follows the same lines, and contains chapters dealing with the habitat, appearance, distribution, dress, dwellings, industries, games, laws and customs, religion, folklore, and language. In addition, Sir Charles Lyall has added to his book, a chapter on the position of the Mikirs in the Tibeto-Burman family. The scope of each book is sufficiently shown by these chapter-headings, and when it is remembered that the authors are such authorities as Sir Charles Lyall and Mr. Hodson, every one may rest assured that the information given is thoroughly reliable and up to date.

In conclusion, it may be permitted to congratulate the Government of Eastern Bengal and Assam, on having put this coping-stone to the work already done. It has placed ethnologists under a debt of gratitude, and it is to be hoped that other governments will follow its lead, and that before long we shall have a similar authoritative set of monographs dealing with the other native races of the British Empire.

H. S. K.

### Early History of Ceylon.

'The History of Ceylon from the Earliest Times to 1600 A.D., as related by João de Barros and Diogo do Couto.' Translated and edited by Donald Ferguson. Colombo: 1909. 445 pp.

In this publication, which has been reprinted from the Journal of the Ceylon Branch of the Royal Asiatic Society, Mr. Ferguson has translated all the passages relating to Ceylon to be found in the decades of Barros and Couto, prefixing thereto

a brief account of the lives and works of those two historians. The translation has evidently been made with great care, and, supplemented as it is by abundant and valuable notes, it cannot fail to be of much service to English readers desirous of studying these standard authorities for the connection of the Portuguese with Ceylon.

## The Himalayas.

'A Sketch of the Geography and Geology of the Himalaya Mountains and Tibet.' By Colonel S. G. Burrard, R.E., F.R.S., and H. H. Hayden, B.E., F.G.S. Part IV. 'The Geology of the Himalaya.' *Price Rs.2.*

This paper forms the fourth and concluding part of the work on the geography and geology of the Himalayan area, of which the first three parts were noticed in the *Journal* for October, 1908. The geology of the region has been dealt with by Mr. H. H. Hayden, of the Geological Survey of India. Mr. Hayden is particularly qualified to write on this subject. He possesses unrivalled knowledge of the area under discussion, and is, perhaps, the most experienced trans-frontier geologist living. Not only has he worked extensively in Kashmir, Spiti, Ladakh, and the high regions north of Kashmir, and in Western Tibet, but he accompanied, in the capacity of geologist, the Tirah expedition of 1897–98, and the Tibet Mission in 1903–04. Added to this, he spent some two years attached to the Court of Kabul, where he had opportunities for travelling in Afghanistan which have been accorded to few others. With all this accumulated experience, no better officer could have been selected for the difficult task of writing a summary of all that is known of the geology of the Himalaya. The value of his work is further enhanced by the clear and lucid style in which he writes; indeed, this feature is characteristic of the whole series of papers.

The author divides the Himalayan system, for geological treatment, into three zones. The sub-Himalayan Zone, on the south side (embracing the comparatively low foothills), which occupies a belt extending throughout the whole length of the Himalaya. It is composed, for the most part, of rocks belonging to the Tertiary age. Inside this, and more or less parallel to it, lies the Himalayan Zone, comprising the Lesser Himalaya and the high central peaks "composed of granite and other crystalline rocks, and a great group of unfossiliferous sediments of unknown age." Lastly, the Tibetan Zone, lying north of the line of the high peaks, constituting "a series of highly fossiliferous sediments ranging in age from the Cambrian to the Tertiary periods." This system of division forms a basis on which to build the details of the geological structure, into which it would be impossible to enter here.

There is always a certain fascination connected with speculation as to the past, just as there is when we attempt to dip "into the future far as human eye can see." In this work Mr. Hayden endeavours, from geological evidence, to reconstruct the ancient topography of the Indian area, and to indicate the relative distribution of land and sea at the various stages of past history. On p. 257 we find an admirable summary of the conditions which prevailed during the various periods. In the Purana era—the earliest that can be traced from geological records, and of pre-Cambrian age—the Indian Peninsula and the Himalayan area were sunk beneath a great sea, which may have extended to China. At the close of this era there is evidence of volcanic activity, and a glacial epoch. In the Dravidian era occurred the "emergence, and conversion into dry land, of Peninsular India and the southern part of the Himalayan area." In the last, or Aryan era, there was an extension of continental conditions in the Himalayan area. What are now the northern slopes of the Himalaya became the southern shores of the Tethys sea,

which covered much of Central Asia. In the Tertiary epoch of this era began the period of mountain-building, the "final emergence of the Himalaya and Tibet, and the disappearance of the Tethys." The author, in a most interesting sketch, traces these various stages in some detail.

A section is devoted to the age of the Himalaya. That this mountain system, like the Alps, is geologically young is now accepted. It is not older than the Tertiary epoch. The fact that many of the rivers are re-excavating their channels tends to show that the process of elevation is still in progress; and the frequent occurrence of earthquakes indicate that a state of stability has been by no means reached. The origin of the deep-cut river gorges of the Himalaya has given rise to some speculation. We do not know whether it has been pointed out before, but there seems to be a curious resemblance, on a small scale, between the behaviour of the Rhine and the Rhône, and of the Indus and Brahmaputra, at least in their upper reaches. In both cases the pair of rivers rise near each other, and behind a great mountain range flow in opposite directions for some distance along what appear to be original tectonic valleys; then they turn at right angles and cut through the main axis of elevation. We wonder if a close study of the two European rivers, a comparatively easy matter, would help to elucidate problems connected with their two great Indian counterparts?

The last section of the paper is devoted to the economic geology of the Himalaya. Though the list of minerals which occur in the area is large, their economic value is small, and only three industries can be said to be established on a commercial basis; these are salt and slate quarries in Kangra district, and the sapphire mines of Kashmir.

A set of admirably reproduced maps and sections accompany the paper. Scenery is so intimately connected with geological structure that there might have been included, with advantage, typical views combined, where possible, with geological sections, such as have recently been employed by Dr. Carl Schmidt, of Basle, to illustrate his writings on Swiss geology. For the general reader these add considerably to the interest and attraction of works of this nature.

We suggest, for a future edition, that the plates might be bound with blank spaces the size of a page, so that they could be completely unfolded beside the volume, thus greatly facilitating reference to them.

There is one point the geological map of the Himalaya brings out prominently, namely, how much still remains to be done. Nepal, for instance, is almost a complete blank. This is, however, due to circumstances over which the geologist has no control.

H. L. CROSTHWAIT.

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'Asie-Mineure et Syrie (Sites et Monuments).' By Eugène Gallois. (Paris: Guilmoto. *n. d.* Pp. 246.) This is a simply written little book, which would be useful as a work of reference if it had an index or even a detailed table of contents. As it stands, it would be very hard to find the succinct account of any given town, which, however, is there to be found.

'The City of Jerusalem.' By Colonel C. R. Conder. (London: Murray. 1909. Pp. viii., 334. *Maps and Illustrations.* 12*s.*) This volume contains a *résumé* of the history of Jerusalem as it has been pieced together from the results of research and exploration. It is clearly written, has numerous textual references and a bibliography, some good maps of the city at early periods, and an indifferent modern map, so heavily shaded as to be in large part illegible.

## AFRICA.

### Kharga Oasis.

'An Egyptian Oasis.' By Llewellyn Beadnell. London: Murray. 1909. Pp. ix. and 348. *Price* 10*s.* 6*d. net.*

Recently quite a number of works have appeared dealing especially with more or less rainless regions, but though such regions have necessarily much in common with one another, they have each much that is distinctive. The oases of Northern Africa have long been known and regarded as one of the wonders of the continent. If their marvels are diminished by more intimate knowledge, the interest which they arouse still remains unaltered.

This account of the Egyptian oasis of Kharga is of much geographical value, for the author has had exceptional opportunities for becoming acquainted with it as well as with the others in the Libyan desert, both while on the Geological Survey of Egypt, and since then when in charge of land-development operations near Kharga. The depressions in which these oases lie occupy large areas in the Libyan desert, but the fertile tracts within them are very limited, and depend wholly upon their artesian wells, which have for at least some four thousand years enabled a scanty population to exist. Until the Kharga railway was laid recently, communication with the Nile valley was difficult, being kept up by camel caravans, which traversed the numerous desert roads connecting the oases with the fertile plains of Egypt, and some of these roads are described in detail.

The geology and topography are dealt with fully, and the author's recent work has increased our knowledge by the interesting discovery that the extensive deposits of sand and clay which occur in the centre of the depression were laid down in a former lake. These deposits cover two large tracts, of which the northern is about 45 miles and the southern about 30 miles from north to south, while their average breadth is about 8 to 10 miles. These large bodies of water are ascribed to heavier rainfall of Pleistocene times, or to the waters which may have escaped from the underlying water-bearing beds by bores or natural springs, and it is suggested that the present arid conditions have since caused their gradual desiccation. The author considers that these lakes existed well into historic times, though we have no reference to them in any inscription or by any classical author. A further study of these deposits should be of great importance, for Egypt seems to offer special opportunities for tracing back the human race beyond the predynastic stage of the archæologist into the later part of the humid period which preceded the present aridity of these regions.

The construction of the railway to Kharga has furnished reliable levels from the Nile valley to the oasis, and Kharga village proves to be 58 metres above the Mediterranean. Using this revised datum in the oasis, it now appears probable that few parts of it are below sea-level, the lowest point yet determined (+2·6 metres) being near the village of Gennah, nearly 1300 feet below the surface of the desert plateau.

The villages of the oasis fall naturally into two groups—the northern ones near Kharga village, and the southern group of Beris, Mex, and Dush. All these are described, and a full account is given of their cultivation and their water-supply.

A very detailed description is given of the artesian wells to which the oases owe their existence, and this is the most valuable portion of the work, since a large number of recent observations are included, which are the first to give any accurate data for studying the underground water-supply of this region. Two sources of supply are discriminated—the surface-water sandstone, some 45 feet thick, and the artesian-water sandstone which lies beneath it, and measures 390 feet in thickness;

it is probable that the former has derived its water from the latter. The original source of the water in the lower sandstone has been variously ascribed to the swamps of the Bahr el Ghazal, the rainfall in Kordofan, and to the percolation of water from the Nile into the Nubian sandstone. Whatever may have been the case in the past, it is the last of these that most probably has the greatest effect to-day in maintaining the saturation of the desert sandstone. In this connection a series of measurements of the volume discharged by the Nile at Merowe and at Wadi Halfi would furnish information of the greatest value and interest concerning the loss of water from the river and the supply of it to the sandstone strata, if carried on for a year at least. A perusal of the interesting and valuable data here collected, which show how readily wells are affected by others near them, demonstrates clearly how essential it is that the wells and well-boring in the oases should be supervised by a central authority, and be in charge of individuals who are well acquainted with the underground structure of the region. The geological reports on the oases pointed out this necessity some years ago; but its importance has not yet been realized, though Algeria presents a most valuable object-lesson in the development of the resources of its oases by work carried out on a scientific basis. Even with such a permanent water-supply as is usually obtained by boring, the cultivator's margin between success and failure is not a large one, and a full study of all the conditions is an essential preliminary to aiding him.

The numerous photographs greatly aid the reader in forming a correct idea of this curious and interesting region, but the maps are inadequate. Two sketch-maps on a small scale can contain but a few names, while the book abounds with references to places which will not be found in them. A general map of the oasis already exists, and this, with the corrections and additions that the author mentions in his work, would have greatly added to the value of this important addition to the geographical literature of arid regions. Where the climatic conditions are so strongly marked in their effect, and existence is a long struggle against them with such aid as the water-supply affords, geographers would have welcomed a fuller account of these conditions than is given incidentally in describing different portions of the oasis. Meteorological observations have been taken in both Kharga and Dakhla oases, but they are not very numerous, and a full account of the climate by one having the author's long experience would have been both interesting and valuable. Metric, British, and Egyptian units of weight and measure are employed, but the uniform employment of either of the two first would have been preferable.

H. G. L.

### Pre-historic Rhodesia.

Pre-historic Rhodesia: an examination of the Ethnological and Archæological Evidences as to the Origin and Age of the Rock Mines and Stone Buildings, with a Gazetteer of Mediæval South-East Africa.' By R. N. Hall, author of 'The Ancient Ruins of Rhodesia.' London: T. Fisher Unwin. 1909. *Illustrations, Maps, and Plans.* 12*s.* 6*d. net.*

When the Portuguese adventurers following on the voyages of Vasco da Gama landed at Sofala (near the modern Beira) and elsewhere along the south-eastern coast of Africa, between the Sabi and the Zambezi delta, they were soon made aware, by the descriptions of the Swahili Arabs and the native Bantu chiefs, of the existence inland of cities and fortifications built of stones, and thus in striking contrast to the general style of habitation in vogue amongst the negroes —ephemeral structures of sticks and grass, to which, perhaps, Arab influence has added the use of plastered clay. These stone cities were spoken of as cemeteries of negro kings or the work of the ancient ones (Ba-ntorotoro). They seemed to

be in some way connected with gold-mining, and were to a great extent included within the kingdom of a powerful negro potentate known as the "Monomotapa." This title may be a corruption of the words *Muene Mutapa*, "Lord of the mine"; or it may be derived from other words in the Bantu languages of south-eastern Rhodesia meaning the "Man-devastator," *Munhu mutapa*. For various reasons the first of the two derivations seems to the writer of this review the more probable Mutapa in the language of Tete may be interpreted to mean "a mine," "an excavation."

A Boer hunter (Adam Renders) and an English ivory trader (George Phillips) rediscovered the most striking of these ruins—Zimbabwe. (This word is a contraction of *Zimba-za-mabwe*, which would mean in the old Karanga language "houses of stones.") These wanderers drew the attention of Karl Mauch to the Rhodesian ruins in 1871. Mauch at once jumped to the conclusion that works of this description could never have been executed unaided by Bantu negroes, and ascribed them to the emissaries of King Solomon or of the Queen of Sheba.

The contention slumbered until the opening up of Rhodesia by the expeditions under Mr. Colquhoun and Dr. Jameson. Then through the action of the late Mr. Cecil Rhodes, their wonders were made known to an astonished world, and Mr. Theodore Bent was the first scientific explorer to give an accurate description of Zimbabwe, revealing thus its extraordinary, parallel, lofty walls of dressed stones, its temples, its conical towers, monoliths (some of which were of soapstone and of somewhat phallic outlines, but with the top carved into the rude semblance of birds), stone phalli, large and small, a chevron pattern round the rims of the lofty walls of dressed stone, stone terraces for the cultivation and irrigation of fields, and other features so utterly dissimilar to any known developments of pure negro culture. Mr. Bent was succeeded as an investigator by Sir John Willoughby and others, and most notably by Mr. R. N. Hall, the author of the work under review, and of a previous book, 'Great Zambabwe,' and part author of 'The Ancient ruins of Rhodesia.'

The general result of these investigations was to convince most people who studied them that south-east and south-central Africa had been at a relatively distant period invaded by adventurers from Arabia or Western Asia, who had built the more ancient of these structures, and had started and carried on a commerce in gold and perhaps ivory. There was absolutely nothing in the architecture of the ruins to suggest Moslem or Saracenic influence (except only in regard to fragments of china and glass). In fact, it was almost decided that here was the land of Ophir with which Solomon had traded indirectly through the markets of Western and Southern Arabia. These conclusions were somewhat violently attacked by Prof. D. Randall McIver, who visited Zimbabwe and one or two other places in 1902, and as the result of his investigations, pronounced all the Rhodesian ruins he had seen, including Zimbabwe, to be at most as old as the fourteenth century A.D., and to be due almost entirely to negro workmanship.

An admitted weakness in Mr. Bent's theory of an ancient Arabian origin for the older of these buildings (dating back, possibly, to times coeval with King Solomon) was the entire absence (so far as investigations have gone) of any inscriptions in the older Semitic languages and writing. There are said to be a few inscriptions in somewhat modern Arabic on fragments of glass. Likewise (according to Dr. Frank Shrubsall), the only human remains as yet discovered in any of the graves or cemeteries, or under the walls of the buildings, are of modern Bantu negro type.*

Mr. Hall freely admits that much of the ruder stonework may have been accomplished by Bantu negroes, who succeeded the vanished exotic race of gold-seekers, and in carrying on their business, very imperfectly (no doubt) imitated

* See p. 577.

with *undressed* stones the dry masonry work of the splendid walls and neatly constructed towers they saw around them. But Mr. Hall, in common with a large number of authorities who are intimately acquainted with the Bantu negroes of Africa, finds it impossible to believe that Zimbabwe and similar stone cities could ever have been constructed by unaided Bantu negroes, or any other known negro race existing in Africa. The stone phalli and the carved birds, the signs of the zodiac, and much gold work are utterly unlike any known culture amongst the negroes south of the equator; and even where any parallel developments can be quoted of negro Africa north of the equator, they are obviously traceable to a foreign (Libyan, Egyptian, Arab, or Galla) influence. But in *South* Africa, most of all, are such evidences of art and architecture and religious belief as those displayed at Zimbabwe entirely incongruous with all we know of the Bantu, Hottentot, or Bushman people, past and present.

Mr. Hall makes no reference to an alleged interesting discovery reported within the present year of one or more coins of the Maccabees in northern Natal.

The mystery of Zimbabwe still remains unsolved.

If Mr. Bent's conclusions, and the suppositions of Prof. A. H. Keane, Mr. R. N. Hall, and other advocates of an Asiatic colonization of South-East Africa by gold-seekers prior to the Muhammadan or even the Christian Era cannot be confirmed by the evidence as yet collected, neither can Prof. MacIver's deductions be accepted as to the recent or the purely Bantu construction of the Rhodesian stone cities, forts, and elaborate gold-mining operations. They may, of course, be due to the post-Islamic Arabs, who began to occupy or re-occupy the East African coast from the commencement of the eleventh century A.D. (and in connection with this there should be pointed out the striking resemblance in shape between the conical towers of these Rhodesian ruins and the conical minarets of old mosques at Lamu and other places on the East African coast). But no Arab history or tradition asserts this; rather that these structures were already in existence and even in a state of ruin when the first Muhammadan Arabs began to open up trade with Sofala.

Bantu negroes have nowhere taken any interest in gold, or made any use of gold ornaments, except those that were under the influence of the Portuguese or the Swahili Arabs in the lower Zambezi valley. There is not even an indigenous word for gold in the Bantu languages, though copper and iron are distinguished. The word for gold in any known Bantu dialect is either derived from the English, Portuguese, or Arabic, most often from the latter. In the Zambezi basin, and in the Chi-karanga language especially, gold is *ndurama*, or *ndalama*, which is probably derived from the Arab word for "money"—*dirham* or *darâham*, if not from the word for "gold"—*dhahab*.

Mr. Hall's book, though to a slight extent a re-statement of 'Great Zimbabwe,' and unnecessarily chequered with mistakes in the spelling of proper names (and above all in the transliteration of Portuguese sentences, the correction of which the publishers might well have seen to, as they are possibly only press errors), is of considerable interest. But it does not lead us any further towards a solution of the mystery.

H. H. Johnston.

### Cadastral Survey of Egypt.

'Ministry of Finance, Egypt. Survey Department. The Cadastral Survey of Egypt, 1892–1907.' By Captain H. G. Lyons, F.R.S. Cairo: National Printing Department. 1908. *Price* 400 *milliemes*.

This volume contains an account of the ten years' work expended upon the construction of the great land map of Egypt.

At first sight it may appear somewhat surprising to learn that in this, the most fertile tract of the Earth's surface, where an orderly system of land tenure has been in operation for many thousand years, it was not until the year A.D. 1898 that a serious attempt was made to carry out an accurate land survey. It is true that a system of land measurement has been in use from the earliest days, and not the least interesting part of this volume is the account of the methods employed by the early geometers. If we desired to do so, we could extract figures showing the large sums of money that were wasted in previous abortive attempts at partial surveys not based upon any rigorous framework, and not planned upon any connected system. We could thus illustrate the lesson that bad maps mean waste. This lesson is one, however, that to our readers here needs no driving home, and we will not pause to labour the point.

The problem set before Captain Lyons and his staff when, owing to the necessity for a reassessment of the land tax, it was decided to embark upon a regular survey, was one of no mean difficulty. It may be stated as follows: To carry out a cadastral survey on a scale of $\frac{1}{2500}$ over an area of 7 million feddans (7,266,000 acres) in which more than 40 per cent. of the holdings were under half a feddan, to prepare land registers, and keep up an annual rate of output of from 500,000 to 800,000 feddans, there being no legal compulsion upon owners to attend and point out their boundaries, and the whole subordinate staff being native with little more than elementary education. How successfully this was carried out can be inferred from the volume before us. The total cost, we may note, was £440,000E, a little over a shilling per acre, a sum which amounted to only 9 per cent. of a single year's land tax.

At an early stage of the operations it became obvious that it was only by instituting an almost mechanical system of work, and by carrying the principle of the division of labour to its extreme possible development, that success was to be attained. This is well illustrated in the description of the arrangement of the computing office, where all the work was planned so as to be self-checking, and the system was such as to ensure that any part not up to the requisite standard was automatically rejected. In computing the triangulation the least square solution was adopted, not so much because the precision of the work necessitated its use as that it furnished a mechanical method of obtaining a unique solution. There is much in this volume that cannot fail to prove of value to those who are entrusted with the execution of similar surveys in other countries. We can heartily congratulate Captain Lyons and his staff, not only on the completion of their great task, but also upon the trouble they have taken to place the results of their experience at the disposal of their brother workers.

E. H. H.

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'Guides Joanne: Algérie et Tunisie.' (Paris: Hachette. 1909. Pp. 446, 156. *Maps.* 12 *fr.*) For completeness and clear arrangement this guide needs no recommendation. The printing of the text and maps, however, hardly reaches the standard to which one is accustomed in English or German guide-books.

'Au Pays de l'Or Noir.' By Paul Walle. (Paris: Guilmoto. 1909. Pp. 244. *Maps and Illustrations.* 4 *fr.* 50c.) This volume is chiefly concerned with the productions and trading possibilities of the Amazon and Matto Grosso, and with the importance of Para as a commercial outlet. It is replete with facts and figures, and at the same time is written with an eye to more general interests—altogether a comprehensive and interesting study.

'Notes, Essais et Études sur la Guyane Française.' By A. Dangoise and L. Pottereau. (Paris: Ficker. 2nd ed. (*n. d.*). Pp. 227. *Illustrations.*) 'La Guyane

Française. Nouvelles Notes et Études.' By A. Dangoise. (*Ibid.* 1909. Pp. 237. *Illustrations.*) The second of these volumes is an amplification of the first, so they may be taken together. They are compiled by an obvious enthusiast, and would seem in some cases to minimize too far the difficulties of successful colonization in Guiana. But they form together a useful general survey of the country and its possibilities.

## MATHEMATICAL AND PHYSICAL GEOGRAPHY.

### The Indian Ocean.

**'The Percy Sladen Trust Expedition to the Indian Ocean in 1905, under the leadership of Mr. J. Stanley Gardiner.' Description of the Expedition and Reports 1-21. *Trans. Linn. Soc. London*, ser. 2, Zool., vol. 12, parts 1-5. London: 1907-1909.**

In the series of reports on the results of Mr. Stanley Gardiner's second expedition to the Western Indian ocean, and more particularly in the general account of the expedition, written by himself and Mr. Forster Cooper, we have evidence of much valuable scientific work accomplished in the face of very considerable difficulties. The main object of the expedition was to investigate from every point of view the probability of the former existence of a continent between South Africa and India, but there was also the more general intention of exploring the region in question with regard to its present-day geography, fauna, and flora. No evidence was obtained in favour of the existence of the continent in question, but it is clear that the authors do not consider its possibility by any means excluded.

The expedition was conveyed in H.M.S. *Sealark*, a newly bought surveying vessel lent by the Admiralty for the purpose; and its members evidently experienced from the officers and men of the vessel that hearty and efficient co-operation and hospitality which is invariably extended by the navy to men of science. The *Sealark* was to have left Ceylon in the middle of April, 1905, but, having unfortunately damaged herself in surveying the waters around Port Sudan, was obliged to wait some weeks for repairs at Colombo. Finally on May 9 she was able to sail. Her first serious scientific work was done between the Maldives and the Chagos, where a series of soundings revealed the fact that the Maldive bank tails off in about 75 miles to some 2000 fathoms, and remains at that depth till the Chagos bank begins to rise. A number of plankton observations at different depths were taken in the same locality. On May 19, Ile Diamant, the most north-westerly island of Peros Banhos, was sighted. On landing, it was learnt that the settlement formerly on this island had been moved to Ile du Coin, on account of there being more protection in the latter locality from the south-east trades. After examining and collecting on Ile Diamant, the *Sealark* proceeded to Salomon atoll, where a party landed, while the vessel anchored in the lagoon. The expedition stayed here till June 16, during which time a careful biological and geological examination of the atoll was made, while the officers prepared a very accurate chart. The result should be a study of an atoll which will be of the first importance.

On leaving Salomon, an exploration was made of Peros Banhos, which, like Salomon, has a population of mixed Indian and Negro blood employed chiefly in the coconut oil industry. It is interesting to note that the reef at Ile du Coin appears to be growing both on the seaward and on the lagoon side. In various localities in this atoll considerable changes appear to have taken place since Moresby's survey. From July 7 to 13 the *Sealark* was at Diego Garcia, where she obtained coal from a British-India ship. The opportunity was taken to explore the atoll and lagoon thoroughly. Subsequently some time was spent on Egmont atoll, while the *Sealark* continued sounding round Great Chagos. The lagoon at Egmont is increasing at

the expense of its encircling reefs. At the same time it contains many *Lithothamnium* shoals which would appear to be filling it up. On leaving Egmont the expedition proceeded to Mauritius, obtaining on their way evidence by soundings that there is no connecting bank between the Chagos and the Mauritius-Seychelles line. Port Louis was reached on August 5.

For some three weeks the expedition remained in and around Mauritius, and the general account of the voyage gives a somewhat extensive account of the principal physical features of the island and its waters. On leaving here the exploration of Cargados Carajos was undertaken. The islands are described as barren and without permanent inhabitants, though there is a fish-curing establishment on one of them. On the bank the bottom was peculiarly smooth and level, with a rich fauna. On the rough edge of the bank, in 47 fathoms, the monocotyledonous *Halophila ovalis* was dredged.

The *Sealark* next proceeded along the west side of the Nazareth bank to the Saya de Malha bank, sounding on the way. The greater part of the former bank, which is about 100 miles long by 50 wide, is 30 to 40 fathoms deep, but there are considerable areas within the 20-fathom line. Midway between the two banks a depth of 22 fathoms was obtained. The Saya de Malha bank slopes gradually to the south. In the neighbourhood of this bank there were indications of very strong currents in deep water, often in a contrary direction to the surface current, and in places the bottom was swept clean. From Saya de Malha the ship steamed towards the south-east part of the Seychelles bank, sounding at intervals, and finding a hard bottom in some 800 fathoms, and anchored off Coetivy island on September 10. Here members of the expedition remained while the vessel went to the Seychelles to coal. On September 25 they left Coetivy, after having made an exhaustive examination of the whole island, and extensive collections of its animals and plants. These, however, differ little from those of the Chagos. Farquhar atoll was next visited, after some soundings of 2000 fathoms and thereabouts had been taken between it and Madagascar. The special character of this atoll is the shallow and restricted nature of its lagoon. There is a population of 130, who live by the coconut, turtle, and fishing industries. On October 2 a start was made for Providence reef, 40 miles to the north, with a depth of 900 fathoms between. The reef is 24 miles long, and has an island at its northern end, planted with coconuts, and inhabited by a settlement of workmen from the Seychelles. St. Pierre, 17 miles to the west of Providence, was next visited, and thence the vessel steamed by Alphonse to the Amirante islands, where the expedition remained, dredging and exploring, till October 18. Considerable change appears to be taking place in the Amirante islands. From here a course was set towards Bird island, Seychelles, round which some dredging was done, which revealed a very rich fauna. At last, on October 20, the end of the cruise was reached at Port Victoria, Mahé, where Messrs. Gardiner and Cooper parted with the *Sealark*. The expedition remained in the Seychelles till December 8, making observations on the geology of the islands and collecting the peculiar fauna of the indigenous jungle.

Besides the general account of the expedition, of which we have given an outline, the volume of the *Linnean Transactions* under review contains a number of reports by various specialists on a part of the collections brought back by the expedition. Of these we may particularly note Mr. Tate Regan's report on the very fine collection of fishes; Mr. Gardiner's own article on the Fungid corals, which amounts to a complete review of the family; and Mr. Gepp's account of the sea-plants. The whole forms a record of a very fine piece of work, and we offer the members of the expedition our hearty congratulations on their achievement.

L. A. B.

# THE MONTHLY RECORD.

## EUROPE.

**The Seiches of Loch Earn.** — *The Transactions of the Royal Society of Edinburgh* (vol. 46, part iii., Session 1908–09) contain an article by Prof. Chrystal entitled 'An Investigation of the Seiches of Loch Earn by the Scottish Lake Survey.' A description of the limnograph and methods of observation employed were given by Prof. Chrystal in a former contribution, the present paper discussing mainly the nature and causes of the seiches, with an elaborate mathematical appendix. Owing to the comparatively regular shape of its basin, and the great depth of the lake in comparison with its length, the seiche phenomena of Loch Earn are very regular and persistent; in fact, the loch is rarely free from seiches. Many causes may generate a seiche, and the magnitude of their effects is approximately calculated by Prof. Chrystal, assuming, of course, ideal conditions. The most potent of these causes, in the case of Loch Earn, at any rate, seems to be the local minor variations of atmospheric pressure as indicated by the microbarograph. A lake surface, as comparison between the traces of the limnograph and microbarograph reveals, is extremely sensitive to these minor fluctuations of the atmospheric pressure, which are so local that one part of the lake is at any moment subjected to greater pressure than another. Sometimes these microbaric disturbances are slow and periodic, and at other times transitory, accompanying the passage of squalls or other atmospheric disturbances; but in either case they are associated with the generation of a seiche over the surface of a lake. Another noteworthy cause of seiches is wind denivellation—the transport of water in the direction of a long-continued wind. The sudden release of this wind denivellation is apt to originate a seiche. In the case of shallow lakes, like Lake Balaton, for instance, this cause is very important, but not in the case of deep lakes, like Loch Earn, as the return current readily forms and prevents the accumulation of wind denivellation. The observations to determine the nodes of Loch Earn were very difficult. The uninode and two binodes were found to be situated not far from their calculated positions, but only the eastern of the three trinodes was determined by direct observations. This subject of seiche-disturbances is one of great interest to physicists. It should be remembered further that seiches occur not only of the water-level, but also of the temperature of lakes.

**The Fjords and Coastal Canals of Norway.**—In a 'Contribution à l'étude des Fjords et des Chenaux latéraux de Norwège,' published by Mons. Camille Vallaux in the *Annales de Géographie* (vol. 18, No. 99, of May 15, 1909), the results of meteorological and oceanographical observations made on board the advice-boat *Bougainville* during a week's cruise in the Norwegian seas during August, 1907, are discussed, together with a general review of facts bearing upon the hydrology of the Norwegian fjords and lateral canals. Perhaps the most interesting feature to be referred to in connection with the hydrology of the west coast of Norway is the great volume of water discharged into the fjords by the melting of the mountain snow and ice in summer. The cataracts proceeding from the Norwegian glaciers in summer are bigger than those of the Alps in similar conditions, and this is due to three causes—the heavy precipitation, the great depth of snow accumulated during the long winter, and the rapid melting of snow in summer, consequent upon the great concentration of solar heat associated with the almost perpetual day. There is thus an accumulation layer of fresh water formed on the surface of the fjords which receive all this melted snow and ice, and where present it is known to sailors as *eau morte*. The height of the tidal-wave is not

great along the Norwegian coast, there being a rise and fall in the water-level of 1·5 metre only at Bergen, but the tidal currents are very rapid in the lateral canals, especially in the Karmsund, Vatleström and Skatetrommen. In the great fjords, such as the North Fjord and the Sogne Fjord, the tide is scarcely felt at the inner ends, but at the openings the tidal waters occur at a depth of a few metres below the surface, and carry above them the great body of fresh water just referred to, falling into the fjords from the land.

**The Flow of Danube Water to the Rhine.**—In connection with the underground passage of water from the Upper Danube to the Rhine (*Journal*, vol. **31**, p. 440), it is interesting to learn from a note in *Globus* (vol. **96**, p. 195), based on a paper by Baurat von Pragstein, that a scheme has been set on foot to put a stop to the waste that now takes place, with such ill results to the dwellers on the banks of the Danube, by the construction of a weir across that river near Immendingen. Thence a canal would be taken, a distance of 12 kilometres (7½ miles), to the point where the water reappears to feed the Aach, the inhabitants of whose valley have resented attempts to diminish their water supply. It would, of course, be necessary to stop up the existing leakage places, but, this being done, it is calculated that from 500 to 700 litres (17·6 to 24·6 cubic feet) per second would be preserved to the Danube, thus saving it from drying up entirely in summer as at present.

**Settlement of a District in Brandenburg.**—A careful study in regional geography is supplied by H. Jung's 'Beiträge zur Siedelungskunde der Zauche,' a dissertation for the degree of Doctor at Halle-Wittenberg University. The region, the character of which is illustrated by eight views, is by nature, as still in part actually, a fen, lying in the diluvial tract of north-eastern Germany, and bounded on the north by the Havel, on the south and west by the valley of the original Baruth stream, on the east by the Nuthe. Among towns it includes Brandenburg, Potsdam, Brück, Luckenwalde and Woltersdorf. Lying in a domain centuries long under Slavonian rule, the history of its settlement is traced also through pre- and post-Slavonian times. With an area of 535 square miles, the region has 194,924 inhabitants, or an average of 364 to the square mile. Excluding the three largest towns, which engross the bulk of population, there remain 492 square miles occupied by 115 rural towns and villages, with a population of 60,008—122 to the square mile. Excluding places of more than 1500 inhabitants, the density shrinks to 83 per square mile. Determined geologically and in respect of ways of communication, the settlements lie either on or in the immediate neighbourhood of the frontier between diluvium and alluvium, or in the midst of one of these formations. A large section of the dissertation is devoted to the form of settlement. Altogether, the paper elucidates searchingly the reciprocal relations between geologic structure, quality and utilization of soil, density of population and distribution of live stock, the two latter items being further influenced by rail- and water-ways. In a region by nature a mere waste, flourishing industries and rich villages, surrounded by spacious gardens and beet-root fields, now alternate with wide forests, through which one may wander for hours without sight of man or settlement.

**The Climate of Sweden in the Post-Glacial Period.**—Dr. Gunnar Andersson discusses the evidences which testify to the nature of the climate of Sweden in the epoch following the Glacial period in a paper entitled 'The Climate of Sweden in the Late Quaternary Period,' and published in *Sveriges Geologiska Undersöknings Årsbok*, 1909. To judge from the distribution of fossiliferous remains in various deposits, it would seem that after the Glacial period the climate of Scandinavia became warmer than it now is, the summers being longer (as determined by the period of active vegetation), and about 2·5° C. warmer, whilst

the winters were about the same as now or slightly warmer. In particular the hazel (*Coryllus avellana*) extended much farther north in Scandinavia than it now does, the period of vegetation at the time of its widest distribution having probably been 2·4° C. warmer than now. The northern limit of the ivy (*Hedera helix*) and of the yew (*Taxus baccata*) is dependent more on winter than on summer temperature, coinciding almost exactly with the winter isotherm (winter reckoned as December, January, and February) of −3·5° C.; and the inference from palæontological facts is that the winters of the Post-Glacial period, despite the longer and warmer summers, were not materially warmer than now. The oak (*Quercus pedunculata*) and pine (*Pinus sylvestris*) were conspicuous, besides the hazel, for their formerly greater northern range. Theories held by various authorities as to the causes of climatic change operating through geological ages are considered in this paper. Changes in the eccentricity of the Earth's orbit or in the inclination of the Earth's axis to the ecliptic might be answerable for such climatic variations as have probably occurred in Sweden within, geologically speaking, recent time.

## ASIA.

**Nieve Penitente in the Himalayas.**—The phenomenon known as *nieve penitente*, first noticed in the Andes, but subsequently found to be common to snow-clad tropical mountains, was referred to in this *Journal* in the year 1905, and discussed more fully during 1908. Dr. Hunter Workman, who first observed the phenomenon in the Himalayas, gave an account of *nieve penitente* forms in an article entitled 'An Exploration of the Nun Kun Mountain Group and its Glaciers,' published in this *Journal* for January, 1908. Latterly, in the *Zeitschrift für Gletscherkunde*, III. Band, 1909, he has classified and explained these snow-forms in some detail. *Nieve penitente* is a fanciful name given to snow or ice pinnacles or other upward-projecting forms. The general cause of the phenomenon may be attributed to the action of heat in some manner or another upon *névé* and glacial surfaces, in which dense foci already exist; this melting away the softer portions and leaving the harder as standing or upward-projecting masses. From an extensive series of observations on *nieve penitente* found in great abundance under a variety of conditions during the summer of 1908, in the course of an exploring expedition to the Hispar glacier, on the Hunza-Nagar frontier of Northern India, and other localities in that region, Dr. Hunter arrives at conclusions which substantially confirm his former opinion of their origin. The preliminary condition essential for the development of the *nieve penitente* appears to be the striation in parallel ridges, separated by furrows, of the *névé* surface out of which they are evolved, such striation being caused by various agencies, such as the passage of avalanches, wind, the falling of rocky boulders upon the surface, the settling down of the *névé* on sharp slopes, etc. The ridges, however formed, run almost always in the same direction as the slope of the surface, and alter their trend in accordance with it. The first stage in the development of *nieve* pyramids from these simple ridges is "mammillation" in them, proving that some parts of the ridges are harder than others, containing foci of special density. The sun's heat melts away the softer portions, leaving, as aforesaid, the *nieve* forms as variously shaped projecting masses. An interesting variety of *nieve penitente* is that connected with glacial tables. Heavy boulders of granite or other rock falling on a glacial surface compress the *névé* beneath them into columns much denser than the surrounding *névé*. The density of these columns and the protection afforded to them from the sun's direct rays by the rock covering, which is too thick to permit the sun's heat to penetrate it, cause them to persist as shafts supporting the rock tops after the surrounding soft *névé* has melted away, thus forming glacial tables. Little by

little, the sun's heat melting the southern side of one of these ice pedestals more than the northern, the rock-covering begins to tilt towards the south, and finally topples over, leaving the shaft standing behind it, which assumes a more or less pyramidal form. The relatively vertical sun of the tropics seems necessary for the proper production of *nieve penitente*, but hot winds were found by Dr. Meyer to be very effective on Mount Chimborazo.

**The French Railway to Yunnan.**—This important line of communication from the Gulf of Tong-king to Yunnan fu, the chief city of the province, is rapidly approaching its completion, a new section, 301 kilometres (188 miles) in length, having, according to the *Bulletin* of the Comité de l'Asie française, been opened to traffic as far as Pono-hi or Po-si. Beyond that point considerable damage was done by earthquake shocks in May last, but, nevertheless, the work of construction has steadily gone forward, and according to latest advices, only 135 kilometres (85 miles) required to be laid before reaching Yunnan-fu. This last section included two iron bridges over 150 feet in height. Should no unforeseen obstacle arise, the entire length of the line, 531 miles, from Haiphong to Yunnan-fu, would be open to traffic in the early part of 1910.

**Ascent of Three Volcanoes in Java.**—The *Tijdschrift* of the Royal Dutch Geographical Society (2nd series, part 26, No. 3) contains an illustrated account of ascents of the volcanoes of Sindoro, Merapi, and Tangkuban Prahu by Edw. Jacobson. Accompanied by a friend, the writer set out on May 23, 1902, at 12.40 a.m., from Si Gedang, the highest encampment, by way of Si Katok, a coolie hamlet, to the foot of Sindoro. Sindoro is but thinly covered with brushwood and a smooth kind of grass found on many mountains of Java. The top was gained at 5 a.m. The crater had approximately the form shown in the *Jaarverslag v. d. Top. Dienst in Ned. Ind.*, 1905; the eruption (after twenty years' suspension) in the July following this ascent having but little affected its shape. The travellers found its cavity divided into two unequal parts by an incomplete partition wall descending from the eastern wall halfway down to the middle of the pit. Only the southern half of the cavity was in violent agitation; in the middle of it was a large pool, belching out at intervals mud, stones, and steam. The mass thrown out did not rise higher than could be measured in tens of metres, falling back again into the mud pool. On the western edge, at the foot of the steep wall of the crater, there was a big gap, whence a jet of steam issued incessantly with frightful hissing. The descent back to Si Gedang was made in two hours and a half. The ascent of Merapi was made on May 22, 1904, and of Tangkuban Prahu on June 15, 1908.

## AFRICA.

**The Jub River.**—According to a Reuter telegram from Rome on September 21, news has been received from East Africa to the effect that the Jub river has lately formed a new mouth, a violent typhoon having broken through the spit of land dividing the lower reaches of the river from the sea (see map accompanying Commander Dundas' paper in this *Journal*, vol. 1, p. 288). The sea and river-current combined have since made a channel 450 yards wide, and formed a lagoon capable of being converted into a serviceable harbour. The same telegram reports, as an interesting discovery made by the Italian resident, Captain Ferrari (? Captain Ferrandi, long Italian resident at Lugh on the Middle Jub), that the Webi Shebeli does not, as has been supposed, lose itself in the Bali marshes north of the lower Jub, but is a tributary of the latter, which it joins some 120 miles from its mouths. This seems to imply that a divergent branch leaves the Shebeli between the Komia ferry (just north of 1° N.), by which Bòttego crossed the stream when starting on

his last expedition, and the Bali marshes, for there can be little doubt that a part at least of the water finds its way into the marshes. That a connection formed in this way should be permanent does not seem very probable, as the Shebeli at the Komia ferry was a small river only some 18 yards wide and 5 feet deep when crossed by the Bòttego expedition (Vannutelli and Citerni, 'L'Omo,' p. 39). It is not unlikely, however, that at high water some overflow to the Jub might take place.

## AMERICA.

**Survey Work in Canada.**—The Summary Report for 1908 of the Geological Survey of Canada includes some items of geographical interest. Mr. Dowling reports that the steam coals belonging to the Cascade basin of Alberta are calculated to average 150,000 tons to the acre, or 90,000,000 tons to the square mile; or, allowing for dirty seams and coal left in the mine, 65,000,000 tons per square mile. According to explorations by Mr. W. McInnes, the Churchill river, from the entrance of Nemei river to Pukkatawagan and thence to South Indian lake, is a succession of expansions connected by rapids. South Indian lake was found to be 90 miles long by 15 in extreme width, and well over 700 in circumference. Comparatively shallow, it is dotted with islands from 25 square miles in area downwards, the positions of 800 of which have been approximately determined. In the 60 miles' ascent from Nimei to Reindeer Mouth, rapids and falls necessitated eleven postages, but throughout the 70 miles between Reindeer Mouth and Stanley the channel of the river resumes its lake-like character. Between July 18 and September 12, Mr. O. O'Sullivan made a 300 miles' survey of the south coast of Hudson bay, from Severn river to Cape Henrietta Maria. This stretch was found to be of much the same character as between the Severn and York factory. The interior, swampy and mossy, is thinly wooded, and throughout the survey fields of floating ice were constantly in sight. A reputed iron range between Black Sturgeon and Nonwatin lakes, together with the whole region in the vicinity of Lake Nipigon, Ontario, disclosed no bodies of ore of economic value. In August of last year silver was discovered west of Jowganda lake, and in September at Elk lake, in Montreal river district. In a few days all the country to as far as 3 miles west of Gowganda was staked out, and between July and September the surveyor of the area between the east and the west branches of Montreal river counted four *bonâ fide* silver discoveries. So far, the presence of native silver has been authenticated at points over an area of about 10 square miles. In the Tobique country, Victoria County, New Brunswick, a territory of over 190 square miles in area, in the angle formed by the Serpentine river and the headwaters of the Nipisiguit, is currently reported to have twice yielded specimens of gold, but has yet been subjected to no systematic prospecting, for which the land is very unfavourable. Its general geology was found not inconsistent with the occurrence of mineral deposits, including gold.

**Treaty of January, 1909, between Colombia and Panama.**—The text of this treaty, signed at Washington on January 9 last, is printed in the *Boletin del Ministro de Relaciones Exteriores*, Bogotá, March, 1909. It consists of eleven articles, in the first of which Colombia formally recognizes the independence of Panama, while others provide for a settlement of money questions, etc., between the two powers, and one (Art. 9) defines the mutual frontier and provides for the establishment of an Arbitration Tribunal to settle any conflicting claims that may arise. The line of frontier is defined as follows: Starting on the Atlantic from Cape Tiburon, it goes to the head of the Rio de la Miel, and, following the Cordillera by the Cerro de Gandi to the Sierra de Chugargun and Sierra de Mali, it descends by the Cerros de Nigue to the Altos de Espave; thence it runs towards the Pacific to such

a point, and by such a line, as the Arbitration Tribunal shall decide. This tribunal is to be composed of three members, one to be appointed by each of the contracting parties, the third to be chosen by these two members jointly, or, failing agreement between them, by the President of Cuba.

**The Boundary between Peru and Bolivia.**—The award of the arbitrator in this disputed boundary question (the President of the Argentine Republic) was given early in July, but being considered unduly favourable to Peru, was vehemently contested in Bolivia. Negotiations have since been carried on between the two Powers, and have lately (as we are informed by the Bolivian Consul-General) led to an agreement, Bolivia accepting the award of the arbitrator. Whether this applies to the whole or a part of the line originally laid down by the arbitrator does not appear, a solution previously reported as probable being that the two Powers should retain the territory mutually recognized as belonging to each before the award was made, accepting the latter as regards the rest of the territory. The telegram received mentions the particular cordilleras, rivers, etc., to be followed by the new frontier; but in the absence of satisfactory maps of the region it is not yet possible to lay it down correctly.

## AUSTRALASIA AND PACIFIC ISLANDS.

**The Waipoua Kauri Forest of New Zealand.***—The Waipoua Forest, 23,000 acres in extent, is situated in Hokianga County in the north of the North Island of New Zealand. The forest occupies hilly country, consisting of long, mostly level-topped ridges, with rounded sides, running generally east and west, and broken by gullies. Many of the ridges are over 1000 feet high, and the country abounds in streams. In places the forest approaches to within 2 miles of the sea, and on the west ascends a tableland roughly 2000 feet in height. The climate is very wet and comparatively sunless. The annual rainfall, though variable, is well over 100 inches, and there are between 200 and 300 rainy days. Although the forest is north of 36° S., slight frosts occasionally occur even in the lowest portions. The soil varies considerably in different parts, that of the river-flats being, of course, the richest. Certain trees, like the puriri (*Vitex lucens*), mark the richer soils. The subsoil is, generally speaking, a stiff clay, varying in colour from orange and chocolate to nearly white. Within the forest reserve, some of the summits of the ridges, together with a small tract on the south-west, are open. These open patches are characterized by a heath association of plants, in which the manuka (*Leptospermum scoparium*) is the dominant species. This association of plants, called by Dr. Cockayne the "northern heath," has never been described botanically, and requires detailed study from both the scientific and the economic point of view. The vegetation of the forest may be best regarded as consisting of the following plant associations or "formations": (*a*) the kauri-tarairi, in which the kauri and tarairi trees are each predominant in different sub-associations; (*b*) the tawa-tawai-rimu association, in which these three trees figure in varying proportions; (*c*) the swamp association, characterized in some instances by the presence of the kahikatea tree (*Podocarpus dacrydioides*), and in others by the almost complete absence of arborescent growth at all. The two chief and predominant trees of the forest are the kauri and the tarairi, forming the association (*a*) above. The kauri (*Agathis australis*) is a lofty, massive forest tree, having a columnar trunk 4 to 12 feet in diameter and 50 to 80 feet high without branches. The tarairi (*Beilschmiedia tarairi*) is a lofty evergreen tree, possessing a straight

* 'Report on a Botanical Survey of the Waipoua Kauri Forest.' By Dr. L. Cockayne, New Zealand Department of Lands, C-14. 1908.

erect trunk, 1½ to 3 feet in diameter, which is covered with reddish-brown bark, frequently whitened by the growth of a crustaceous lichen. Isolated, or in groups, the kauris rise high above the other members of the forest, leaving a hollow below which is of great beauty. The younger kauris, which are conspicuously different in their mode of branching from the older trees, are green, or green with a bluish tinge and very handsome. The Waipoua forest and one or two smaller reserves are the only virgin kauri forests belonging to the State. Man has already effected considerable changes, due in part to the digging for fossil kauri gum and the climbing of the kauri trees themselves for the raw material. Other changes are being slowly effected by the cattle of settlers and Maoris, and by wild pigs, which trample down the undergrowth and feed on certain shrubs and young trees. Despite the very wet climate, fire sometimes attacks the outskirts of the forest. Some of the tree-ferns in the Waipoua kauri reserve, belonging to the genera *Cyathea*, *Hemitelia*, *Dicksonia*, *Blechnum*, and *Dryopteris*, frequently have trunks of considerable size. The forest contains examples of 241 species of flowering plants and ferns, and is the only example of the kind to be found in the world. Being of great beauty and extreme scientific interest, the rapid clearance of the forest, leaving much waste land with a few farms, is much to be deplored, for it will involve the disappearance of one of the unique attractions of New Zealand.

## POLAR REGIONS.

**The Second Canadian Arctic Expedition**, under Captain Bernier (Cf. *Journal*, vol. **29**, p. 93), returned to Point Amour, Labrador, at the end of September. The objects of the expedition, to take possession of Banks Land and other Arctic lands for Canada, are said to have been accomplished. The *Arctic*, the steamer of the expedition, is said to have been frozen in last winter near an unnamed island in 84° N., a latitude the correctness of which seems extremely doubtful.

**The Norwegian Expedition to Spitsbergen, 1909.**—This expedition, consisting of fifteen men under the leadership of Captain Isachsen, and including two geologists and two topographers, sailed from Kristiania on June 16, returning on September 18. The topographical parties were at work until the middle of August between Ice fjord and King's bay, and also in Prince Charles Foreland, both on the coast and in the interior. During the second half of that month they worked on the northern side of the main island, in the district between Danes island and Wood bay. The geological parties carried out investigations in July in Prince Charles Foreland and on the stretch of coast east of Foreland sound, as well as on the peninsula between English bay and King's bay. In August measurements were made for the purpose of determining the motion and ablation of Lilliehoek glacier, together with an examination of the crystalline schists and eruptive rocks of the interior of the country. During the second half of the month studies of the Devonian formations between Red bay and Liefde bay (Wiche sound), and in the Reindeer peninsula, were carried out. During the first week of September the whole expedition was at work on both sides of Foreland sound, and in the district around Green harbour. Meanwhile, the ship carried out soundings in King's bay and the northern part of Foreland sound, on the basis of the accurate charts prepared by Captain Isachsen in conjunction with the Prince of Monaco. The weather was less propitious for topographical work than in the previous year. Much fog, and (as over the whole of Norway, with the possible exception of Finmark) rain, was experienced. The ice broke up late in the bays. In Foreland sound (which, in the years preceding 1906, had as a rule been tolerably free from ice about the middle of June) it broke up only after the middle of July. On the north coast, ice lay close to the land almost

the whole summer, and only in the last days of August did it move away after some southerly storms. The expedition has brought back a considerable amount of material, which is now being worked out.

**Captain Scott's Antarctic Expedition.**—Since the issue of our last number, Captain Scott has made arrangements for the purchase of the *Terra Nova*, the relief ship of the late National Antarctic Expedition, for his proposed new expedition. In support of his scheme, a meeting was held in the Mansion House on October 12, the Lord Mayor presiding. Captain Scott having detailed the requirements and objects of the expedition, speeches in support of the proposal were made by Lord Goschen and others, and a resolution was passed unanimously promising support to the expedition. A subscription of £1000 towards the fund to be opened was promised by Sir Edgar Speyer.

## GENERAL.

**The Hudson-Fulton Celebrations at New York.**—During the last few days of September and the early part of October, New York witnessed the joint celebration, with imposing formalities, of the third centenary of the voyage of Hudson to the river which bears his name, and of the centenary of the first successful inauguration of steam navigation, by the placing in the same river of Fulton's steamer, the *Clermont*. The leading European Powers took part in the celebration by despatching war-vessels to New York, this country being represented by a squadron under Sir Edward Seymour. The proceedings included a river-pageant, carnival, and various other festivities, the most interesting item in the pageant being the display of replicas of Hudson's ship, the *Half Moon*, and of Fulton's steamer, the *Clermont*. The former was the contribution of Holland (which shares with this country the honour of Hudson's achievements) to the celebration, the replica having been prepared under the superintendence of the Naval Department at The Hague, from the designs of Mr. C. L. Loder, Chief of the Department for Technical Construction. Some account of the construction of the vessel (with illustrations) was contributed to the *New York Times* of May 30 last by Mr. F. W. Jacob, of Veesp, Holland, who has kindly sent us a copy of the paper. It was a matter of some difficulty to obtain data for the design of the vessel, of which no drawing seems now to be in existence. But an intelligent use of such documents bearing on the question as have been discovered permitted the construction of, probably, as close a representation of the original ship as could now be made. This is called both a "yacht" and a "flyboat" in early documents, but the difference between these two types is not of great importance. Both seem usually to have been provided with two masts only, but from a consideration of all the evidence it was decided to represent the *Half Moon* as possessing three. It will be remembered that while Hudson's two first voyages in search of a north-east passage to China (in 1607 and 1608) were made on behalf of the Muscovy Company of London, the third, in 1609, was made at the expense of the Dutch East India Company. The *Half Moon* left Amsterdam on April 4, 1609 (New Style), and its first destination was, as in Hudson's earlier voyages, the north-east; but, being once more baffled in his attempt to push through the ice round Novaya Zemlya, the explorer steered westward in search of a *north-west* passage, and, during the latter part of the voyage, sailed southward along the American coast as far as the Hudson river, of which he was the first to give any certain indication.* His last fatal voyage, to Hudson bay, was undertaken in 1610, again on behalf of

* The Hudson had probably been previously reached by the Florentine Verrazzano, if not (as some have supposed) by a Spanish navigator, Estevan Gomes.

English merchants. The best authorities on Hudson's voyages are Asher's work, published by the Hakluyt Society in 1860, and (for the third voyage) that of H. C. Murphy, published in 1859. The latter has this year been reprinted, with notes and additions ('The Hague:' M. Nijhoff), by W. Nijhoff, Secretary to the newly formed Linschoten Society. A short account of Hudson's career, by T. A. Janvier, has also lately appeared (New York and London: Harper Bros., 1909). It includes a newly discovered record relating to the fourth voyage.

**A Manuscript Notebook of Sebastian Münster.**—It has only lately been recognized that a manuscript preserved in the State Library at Munich, and containing, besides notes and extracts on various subjects connected with astronomy and geography, an extensive series of manuscript maps, was the work of the well-known cosmographer Sebastian Münster. The discovery has been made by Dr. A. Wolkenhauer, who, while engaged on researches on the oldest maps of Germany, had his attention called to the manuscript by Prof. W. Ruge. Dr. Wolkenhauer supplies a detailed description of the manuscript and a discussion of its authorship, date, and the circumstances under which it took shape in the *Abhandlungen der K. Gesellschaft der Wissenschaften zu Göttingen* (N.F., Bd. **11**, No. 3). The contents of the text, which he groups under seven heads, includes notes relating to chronology, mathematics, astronomy, geography, etc., the sections bearing on the last named being the second, based on the 'Margarita philosophica' of Gregor Reisch, and the fifth, consisting of an abstract of Ptolemy's cosmography taken from the Ulm edition of 1486. The first clue to the authorship was supplied by the delineation of the Rhine in one of the sketch-maps, which avoids the errors generally to be found in maps of the period, and shows a striking resemblance to the delineation of the same river in Münster's map of Germany of 1525, which has also been recently brought to light.* Confirmation of the conjecture was found, after long search, in a note at the foot of one of the pages (which had hitherto escaped notice), in which the writer was definitely mentioned as "Sebas. M.," and further proof was obtained on comparison of the writing with that of other known manuscripts of Münster's. A consideration of the facts of Münster's biography throws an interesting light on the probable date and circumstances of the composition of the manuscript. In 1505, at the age of fourteen, Münster entered the university of Heidelberg, but in 1508 he was placed under the care of Conrad Pellikan at Rufach, moving with that teacher to Pforzheim in 1511. About the end of 1514 he went to Tübingen, where he remained for some years under the tuition of the celebrated mathematician Stöffler. The fact that a large part of the manuscript bears evident traces of Stöffler's influence, as exercised by either his published or unpublished works,† together with the reference of the longitudes to the meridian of Tübingen, tends to connect it with the years spent at that place; while internal evidence, adduced by Dr. Wolkenhauer with much skill, makes it almost certain that the bulk was written between 1515 and 1518, though a part seems to date from the time spent under Pellikan's tuition. The maps, forty-four in all, lose some of their importance from the fact that almost all are in the main copies, though in some cases copies from maps that have now become great rarities. Some are taken from the Ulm Ptolemy above referred to, while the rest, including almost all the modern maps, are based on one or other of the maps of Waldseemüller, showing the estimation in which that cartographer was deservedly held at the

* This was described by Dr. A. Wolkenhauer in *Globus*, Bd. **94**, 1908, Heft 1 (see *Journal*, vol. **32**, p. 424).

† Some of Stöffler's works are now lost, and the manuscript may even help to reconstruct some of these.

time. The special maps of European countries are based on Waldseemüller's 'Carta Itineraria Europæ' of 1511, of the original issue of which no copy is now known. Dr. Wolkenhauer devotes especial attention to the map of the Rhine, which is important as probably possessing an originality not to be attributed to the rest. As regards the general character of the manuscript, he considers it to be best described as a "Kollegienbuch," *i.e.* a collection of notes and extracts made in connection with Münster's university studies, or possibly (in the case of some) with courses of instruction given by himself. Facsimiles of the more important of the maps accompany the paper.

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## CORRESPONDENCE.

### Human Remains in Rhodesian Ruins.

Bulawayo, Rhodesia, September 11, 1909.

On my return from a five months' tramp, with native porters, down the Sabi watershed in Mashonaland, I found, greatly to my surprise, the following paragraph circulated in several scientific papers. The paragraph (for all were identical) was as follows:—

"Dr. F. C. Shrubsall gives measurements and photographs of two crania and some long bones in the Natural History Department of the British Museum *that are referred to by Mr. R. N. Hall in his work on Rhodesia*, as having been found in the neighbourhood of the ruins. The contribution they offer to the controversy as to the antiquity of those ruins (which ruins not stated) is that, in Dr. Shrubsall's opinion, they are those of negroes of a similar type to those now found in Rhodesia."

Would you allow me to state that I have never referred to the crania and bones said to be in the British Museum, for the simple reason that until I read the paragraph I was unaware of their existence. Nor should I have done so had it been otherwise, for I should first have required to know in what ruins they were found, under what conditions, whether buried in the midden *débris* of subsequent squatters or other conditions of finding, and with what other articles they were associated, or who was the finder.

Very probably they are negroid remains, for after the abandonment of the older buildings by their original occupiers, the ruins in most instances have been converted into native cemeteries. This was the case in 1560, when the Portuguese records state that the Beza ruins had been converted into a cemetery for "all the *monomotapas* (*munu-mu-tapa* = great receiver of tribute, or 'Great Robber') are buried there," and "they know how many kings they have had." The buildings were never intended for cemeteries, and burials take place in many of them to-day. This explains the natural reluctance of the natives to disclose the location of ruins, lest their burial-places should be disturbed. Numerous graves made in the *debris* of the very last series of subsequent squatters at Zimbabwe were discovered, and at many feet above the original floors, and also completely blocking up important passages. The heads in these graves, Mr. C. H. Read of the British Museum states, belonged to "the fourteenth century, or just possibly to the thirteenth century" (see 'Pre-Historic Rhodesia,' pp. 283–294), which is prior to Prof. MacIver's earliest date for the erection of the Temple!

I do not see how Dr. Shrubsall's statement as to the crania, etc., affects the controversy as to the origin of the culture of stone-building and rock-mining in

these territories. After perusing my 'Pre-Historic Rhodesia' every one must see that I am right in entering this protest.

The only possible explanation for Dr. Shrubsall's reference to myself may be found in Hall and Neal's 'Ancient Ruins of Rhodesia' (p. 107), as to the discovery at M'Telekwe ruins of native remains, with which was a piece of cloth with gold wire or thread woven in the pattern. Livio Sanuto, writing in 1581 of the country of the *munu-mu-tapa*, said, "The people wear cotton worked with gold thread." This is a definite statement made by Mr. Neal and myself as early as 1901, that the remains were negroid. This needed no explanation. Dr. Shrubsall's reference might have been to our note on p. 105, which related to a skull, and an arm and thigh-bone, found in the Chum ruins, West Gwanda, and taken to England by the Hon. Maurice Gifford, in 1896, and given by him to Prof. Thane, who later informed the authors that he had lost these remains, and could therefore give no opinion upon them. From the spot where they were found, and from their associated articles, the authors, who had never seen the remains, later declared them to be negroid of about the fifteenth or sixteenth century. In confirmation it may be said that cotton worked with gold thread was imported up to 1381, either from Persia or India, as the records state that the *munu-mu-tapas* decreed that their people should not wear cotton so worked and imported by foreigners, lest evil should come upon them. This historically recorded fact dates the articles and the remains with which they were buried. Moreover, long before 1581 some of the ruins were declared, by competent writers who had seen them, to be "foundations of ancient castles and palaces," and so "very ancient" that Dos Santos and others dated them to Solomonic times, while De Barros thought they belonged to Ptolemy's Agyzimba—a name of Bantu origin.

RICH. N. HALL.

## Cloud Caps on Snowy Peaks.

The following note, made during a ski-tour on the Jotunfjeld, Norway, last winter, suggests a possible explanation of the cloud phenomenon recorded and sketched by Mr. C. Reginald Enock in the October number of the *Journal*.

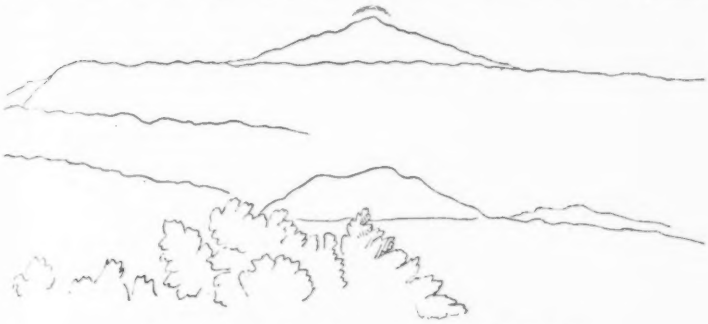
"*February* 21.—Magnificent calm sunny weather while crossing ice of Tyin lake (altitude 3500 feet). 10 A.M. Snow-peaks clear and sparkling against blue sky. A few small but distinct 'slurs' of cloud in the blue northwards. 11 A.M. The 'slurs' on the clear blue are very gradually and slowly coalescing into a level layer of well-marked stratus, which tends to sink towards the mountain-tops."

The phenomenon described by Mr. Enock has never been seen by the present writer. But in Norway light fogs may often be observed floating on still cold air (over a frozen tarn, for example), much as a layer of naphtha would float upon the surface of water. Accordingly, one pictures such a cloud-formation as possible around any snowy summit which had chanced to catch the shade of some high fragmentary cloud in sunny windless weather. The summit would then powerfully chill the air in its vicinity, and be surrounded by a shell of cold air. The shading of a snow-summit in sunny weather by a distant cloud might be a chance circumstance, or one favoured by local climate and local topography. But when this happens, *and a light fog settles upon the peak*, the result would probably be a hollow canopy, which, as it thinned and melted, would be visible in section as a parasol-shaped cloud "obeying the form of the peak."

A. OLDHAM LEES.

Northwood, October 12, 1909.

Referring to my letter and sketches on the matter in the last number of the *Journal*, a correspondent (R. I. Mallett) writes as follows: "I have twice observed a lenticular cloud-cap, such as you describe, on the peak of Teneriffe. I enclose a sketch traced from a photograph, to which I have added the cloud-cap from



Lenticular cloud-cap on peak of Teneriffe seen from Orotava Puerto.

memory, as nearly as possible of the relative size it appeared. I was told it is a common phenomenon there. I think the first occasion was shortly before the first snowfall of last year, and the second after snow had fallen on the peak. It lasted for several hours." I append my correspondent's sketch.

C. Reginald Enock.

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## GEOGRAPHICAL LITERATURE OF THE MONTH.

### *Additions to the Library.*

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.[1]

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are as a rule written in full:—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Col. = Colonies.
Com. = Commerce.
C.R. = Comptes Rendus.
E. = Erdkunde.
G. = Geography, Géographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
Jb. = Jahrbuch.
k.k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. (Mém.) = Memoirs, Mémoires.
Met. (mét.) = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. (Riv.) = Review, Revue, Rivista.
S. = Society, Société, Selskab.
Sc. = Science(s).
Sitzb. = Sitzungsbericht.
T. = Transactions.
Ts. = Tijdschrift, Tidskrift.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half inch. The size of the *Journal* is 10 × 6½.

**A selection of the works in this list will be noticed elsewhere in the "Journal."**

## EUROPE.

**Adriatic—Meteorology.** *Sitzb. A.W. Wien* 117 (Abtl. II. A.) (1908): 783–818. Hann.
Zur Meteorologie der Adria. Von J. Hann.
See note in vol. 33, p. 717.

**Alps—Glacial Erosion.** *J.G.* 7 (1909): 169–172. Fenneman.
Some Anthropo-Geographic Effects of Glacial Erosion in the Alps. By N. M. Fenneman.

**Austria—Galicia.** *Petermanns M.* 55 (1909): 101–107. Smolénski.
Ungleichseitigkeit der meridionalen Flusstäler in Galizien. Ein Beitrag zur Theorie der Asymmetrisationstätigkeit des Windes von Dr. Georg v. Smolénski. *Sections.*

**Austria—Styria.** Klein.
Klimatographie von Oesterreich. Herausgegeben von der Direktion der K. K. Zentralanstalt für Meteorologie. III.: Klimatographie von Steiermark. Von Dr. Robert Klein. Vienna, 1909. Size 11 × 7½, pp. 194. *Map.*
Part 2, by E. Mazelle, was noticed in vol. 33, p. 611.

**Austria—Tyrol.** *Geol. Mag.* v. 6 (1909): 339–346. Young.
Notes on the structure and physiography of the Tarntal Mass. By Alfred P. Young. *Sketch-map, Diagram, and Illustrations.*

**Belgium—Cartography.** *B.S. Belge G.* 33 (1909): 5–33. Gillis.
La carte de Belgique au 100,000e. Par le Lieut.-Colonel Gillis.

**Belgium—Hydrology.** *B.S. Belge Géol.* 22 (1908): *Mém.* 91–102. Andrimont.
Les eaux émergeant des calcaires aux environs de la ville de Marche. Par René d'Andrimont. *Plan and Sections.*

**Belgium—Meuse.** *B.S. Belge Géol.* 22 (1908): *Proc.-Verb.* 366–378. Briquet.
La vallée de la Meuse en aval de Sittard. Par A. Briquet. *Sketch-map.*

**Carpathians.** *Abrégé B.S. Hongroise G.* 36 (1908): 63–80. Schréter.
Ueber die orographischen und glaziologischen Verhältnisse des Pareng-Gebirges. Von Zoltán Schréter. *Sections and Illustrations.* (*Földrajzi Közlemények* 36 (1908): 135–150. *Map, Sections, and Illustrations.*)

**Central Europe—Relief.** *B.S.G. Lille* 51 (1909): 193–219. Douxami.
Les volcans de l'Eifel et les Siebengebirge; la vallée et la plaine du Rhin aux environs de Cologne. Par Henri Douxami.

**Danube.** *J. Manchester G.S.* 24 (1908): 127–130. Dann.
The Historical Geography of the Danube. By E. W. Dann.

**Denmark—Geodesy.** Madsen and others.
Den Danske Gradmaaling; Ny Raekke, Hefte Nr. 3. Præcisionsnivellement; Jylland. Udgivet af Generalmajor V. H. O. Madsen. Efter Gen. Zachariaes Udkast sammenarbejdet af Löjt. N. M. Petersen. Kopenhagen, 1909. Size 11 × 9, pp. 192. *Maps, Plans, and Illustrations.*

**Denmark—Harbours.** K. Søkort-Arkiv.
Det Kongelige Søkort-Arkiv. Forandringer og Tilføjelser Nr. 2 til Den Danske Havne-Lods, 5te Udgave, 1906. Copenhagen, 1909. Size 10½ × 6½, pp. 14. *Plans.*

**Europe—Statistics.** Supan.
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Fifty years of Darwinism: modern aspects of evolution. Centennial addresses in honor of Charles Darwin before the American Association for the Advancement of Science, Baltimore, January 1, 1909. New York: H. Holt & Co., 1909. Size 8½ × 5½, pp. vi. and 274. *Price* $2 *net. Presented by Major Leonard Darwin.*

**Gravity Observations.** *Riv. G. Italiana* **16** (1909): 234–237. **Bianco.**
Determinazioni della gravità sull' Oceano Indiano e sul Pacifico istituite dal Prof. Dott. O. Hecker. Di Ottavio Zanotti Bianco.

**Meteorology.** **Marriott.**
Some facts about the weather. A popular meteorological handbook. By William Marriott. Second and Revised edition. London: Edward Stanford, 1909. Size 8½ × 5½, pp. 38. *Charts and Illustrations. Price* 6*d. Presented by the Author.*

**Meteorology.** ——
Deutsche Seewarte. Tabellarische Reiseberichte nach den meteorologischen Schiffstagebüchern. 5. und 6. Bände: Eingänge der Jahre 1907 and 1908. Berlin, 1908–09. Size 10½ × 7½, pp. (1907) x. and 236; (1908) x. and 244.

**Meteorology—Forecasts.** *J.R. United Service I.* **53** (1909): 474–491. **Rawson.**
A new principle in weather forecasting and its importance in naval and military operations. By Colonel H. E. Rawson.

**Oceanography—Depths.** ——
List of Oceanic Depths received at the Admiralty during the year 1908. London: J. D. Potter, 1909. Size 13 × 8½, pp. 22. *Price* 1*s.*

**Oceanography—North Pacific.** *Ann. Hydrographie* **37** (1909): 17–34, 63–76. **Thorade.**
Ueber die Kalifornische Meeresströmung. Oberflächentemperaturen und Strömungen an der Westküste Nordamerikas. Von H. Thorade. *Charts and Diagrams.*

## ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

**Anthropogeography—Migrations.** *Riv. G. Italiana* **16** (1909): 162–168. **Biasutti.**
L'azione delle correnti oceaniche sulle migrazioni etniche. Di Renato Biasutti.

**Anthropology.** ——
Guide to the specimens illustrating the races of mankind (anthropology) exhibited in the Department of Zoology, British Museum (Natural History). London, 1908. Size 8½ × 5½, pp. 32. *Illustrations. Price* 4*d. Presented by the Museum.*

**Commercial Geography.** **Bishop.**
The Nature of Commercial or Economic Geography. By Dr. Avard Longley

Bishop. (From the *Yale Review* for **May**, 1909.) [New Haven], 1909. Size 9 × 6, pp. 47–62. *Presented by the Author.*

**Commercial Geography.** *G. Teacher* **23** (1909): 6–18. **Markham.**

Exchanges of products between the New and the Old Worlds. By Sir Clements R. Markham.

**Ethnology.** **Kossinna.**

Der Ursprung der Urfinnen und der Urindogermanen und ihre Ausbreitung nach dem Osten. Von Gustaf Kossinna. (From 'Mannus: Zeitschrift für Vorgeschichte,' Band I., Heft 1–2.) Wurzburg, 1909. Size 10½ × 7, pp. 17–52. *Sketch-maps and Illustrations.*

From a new publication devoted to archæology, serving as the organ of the "Deutsche Gesellschaft für Vorgeschichte."

**Historical—Hudson's Ship.** ——

Replica of famous vessel which Holland is sending to America, and which will ascend the Hudson as did the *Half-Moon* of old. (Cutting from the *New York Times*, May 30, 1909.) New York, 1909. *Portraits and Illustrations.*

## BIOGRAPHY.

**Church.** *B. Bureau American Republics* **28** (1909): 478–488. ——

Colonel George Earl Church. *Portraits.*

**Lopez.** *B.R.S.G. Madrid* **50** (1908): 401–543. **Marcel.**

El géografo Tomás López y sus obras. Ensayo de biografía y de cartografía por Gabriel Marcel.

Also published in French (cf. *Journal*, vol. **32**, p. 312).

**Shackleton.** *Travel and Exploration* **2** (1909): 1–10. **Mill.**

Ernest Henry Shackleton, M.V.O. By Hugh Robert Mill. *Illustrations.*

## GENERAL.

**Education—Text-book.** **Kirchhoff.**

Erdkunde für Schulen. Von Alfred Kirchhoff. 15ᵉ Auflage. Two parts. Halle-a.-S.: Buchhandlung des Waisenhauses, 1909. Size 9 × 6, pp. (part 1) 68; (part 2) viii. and 412. *Diagrams. Price* 4m. 20. *Presented by the Publishers.*

**Education—Text-book.** **Reynolds.**

Regional geography: Africa and Australasia. By J. B. Reynolds. London: A. & C. Black, 1909. Size 8½ × 5½, pp. 128. *Sketch-maps and Illustrations. Price* 2*s.* *Presented by the Author.*

**Encyclopædia.** **Meyer.**

Meyers grosses Konversations-Lexikon. Ein Nachschlagewerk des allgemeinen Wissens. Sechste . . . Auflage. Vols. **18–21.** Leipzig, etc.: Bibliographisches Institut, 1908–09. Size 10 × 6½. *Maps, Plans, and Illustrations. Price* 10m. *per vol.*

This edition is now complete.

**Glasgow Geological Society.** **Macnair and Mort.**

History of the Geological Society of Glasgow, 1858–1908, with biographical notices of prominent members. Edited by Peter Macnair and Frederick Mort. Glasgow, 1908. Size 8½ × 5½, pp. vi. and 304. *Portraits and Illustrations. Presented by the Geological Society of Glasgow.*

**Travels.** **Hale.**

The adventures of John Smith in Malaya, 1600–1605. By A. Hale. Leyden: E. J. Brill (late), 1909. Size 9 × 6. *Price* 10*s.* 6*d.*

Purports to be based on the Journals of an Englishman whose real name is not given.

**Voyage of the "Planet."** **Various authors.**

Forschungsreise S.M.S. *Planet*, 1906–07: herausgegeben vom Reichs-Marine-Amt. I. Band: Reisebeschreibung, bearbeitet durch Kap. Lübbert nach Kap. Lebahn (pp. xviii. and 104); II. Band: Aerologie (pp. iv. and 124); III. Band: Ozeanographie, von Dr. W. Brennecke (pp. x. and 154); V. Band: Anthropologie und Ethnographie: Beobachtungen und Studien von Prof. Dr. A. Krämer (pp. x., 152, and 12). Berlin: K. Siegismund, 1909. Size 12 × 9. *Maps, Illustrations, and Diagrams. Presented by the German Government.*

# NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

## EUROPE.

**Austria.** — **Freytag.**

Uebersichtskarte der neuen Tauernbahn. Bearbeitet von G. Freytag. Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. Vienna: G. Freytag & Berndt, [1907]. *Price* 0.30 *kr.* *Presented by the Publisher.*

**Austria-Hungary.** — **Hanau.**

Triaskarte der Habsburger Monarchie von Heinrich Hanau. Scale 1 : 1,500,000 or 1 inch to 23·7 stat. miles. Vienna: G. Freytag & Berndt, [1909]. *Presented by the Publisher.*

**British Isles—England.** — **Railway Clearing House.**

Official Railway Map of the Lancashire and Cheshire Districts. Scale 1 : 140,000 or 1 inch to 2·2 stat. miles. Prepared and published at the Railway Clearing-House, London, 1909.

**British Isles—England and Wales.** — **Ordnance Survey.**

Sheets published by the Director-General of the Ordnance Survey, Southampton, from September 1 to 30, 1909.

County Diagrams, 4 miles to 1 inch, showing civil parishes, with a table of their areas. Norfolk. *Price* 6*d.*

**4 miles to 1 inch.** Revised (second edition):—
In outline, 4. 1*s.* 6*d.* (*engraved*).

**1-inch** (third edition):—
In outline, 130, 132. 1*s.* *each* (*engraved*).
Hills in black or brown, 130, 132, 182. 1*s.* *each.*
Large-sheet Series, printed in colours, folded in covers or flat in sheets, 45, 47, 54, 110, 114. *Price, on paper,* 1*s.* 6*d.*; *mounted on linen,* 2*s.*; *mounted in sections,* 2*s.* 6*d.* *each.*

**6-inch**—County Maps:—
**Hampshire** (Second Revision), 5 sheets. **Kent** (Second Revision), 5 sheets. **Lancashire** (First Revision of 1891 Survey), 3 sheets. **Lincolnshire** (First Revision), 20 sheets. **Yorkshire** (First Revision of 1891 Survey), 12 sheets. 1*s.* *each.*

**1 : 2500 Scale**—County Maps:—
**Cheshire** (Second Revision), 38 sheets. **Hampshire** (Second Revision), 58 sheets. **Kent** (Second Revision), 9 sheets. **Lancashire** (First Revision of 1891 Survey), 11 sheets. **Sussex** (Second Revision), 39 sheets. **Yorkshire** (First Revision of 1891 Survey), 67 sheets.

*E. Stanford, London Agent.*

**Central Europe.** — **K. Preuss. Landesaufnahme.**

Uebersichtskarte von Mitteleuropa. Herausgegeben von der Kartogr. Abteilung der Kgl. Preuss. Landesaufnahme. Scale 1 : 300,000 or 1 inch to 4·7 stat. miles. Sheet: Dresden. Berlin: R. Eisenschmidt, 1909. *Price* 1.50 *m. each sheet.*

**Germany.** — **K. Preuss. Landesaufnahme.**

Karte des Deutschen Reiches. Scale 1 : 100,000 or 1 inch to 1·6 stat. miles. Sheets: (Umdruckausgabe) 623, Augsburg; 624, Freising; 625, Erding. Berlin: R. Eisenschmidt, 1906-09. *Price* 1*m.* *each sheet.*

**Norway.** — **Norges Geografiske Opmaaling.**

Topografisk Kart over Kongeriget Norge. Scale 1 : 100,000 or 1 inch to 1·6 stat. mile. Sheets: 9D, Tönsberg; 46B, Melhus; L10, Hamaröy. Christiania: Norges Geografiske Opmaaling, 1908-09. *Presented by the Norwegian Geographical Institute.*

**Norway—Christiania.** — **Norges Geografiske Opmaaling.**

Kristiania Omegn. Scale 1 : 25,000 or 2·5 inches to 1 stat. mile. Sheet iv. Christiania: Norges Geografiske Opmaaling, 1909. *Presented by the Norwegian Geographical Institute.*

**Sweden.** **Generalstab, Stockholm.**

Generalstabens Karta öfver Sverige. Scale 1:100,000 or 1 inch to 1·6 stat. mile. Sheets: 63, Umeå N.V., S.V.; 70, Husum N.V., N.O.; 74, Indal N.O., S.O.; 75, Härnösand N.V., N.O., S.V. Scale 1:200,000 or 1 inch to 3·2 stat. miles. Sheets: 54, Åsele; 59, Hotagen. Stockholm: Generalstabens Litografiska Anstalt, 1908–09. *Presented by the Swedish Government.*

## ASIA.

**Tong'king.** **Service Géographique de l'Indo-Chine.**

Cartes des Deltas du Tonkin. Scale 1:25,000 or 2·5 inches to 1 stat. mile. Sheets: 1, Vietri; 2, Vinh Yen; 3, Binh Xuyen; 6, Phu Quang; 11, Nhan Ly; 18, Phu Quoc Oai; 37, Phu Ninh Gian; 38, Kien An; 44, Phu Duc; 45, Cua Thai Binh; 51, Dong Quan; 58, Cua Tra Ly; 63, Nam Dong. Hanoi: Service Géographique de l'Indo-Chine, 1904–07.

## AFRICA.

**Africa.** **Geographical Section, General Staff.**

Map of Africa. Scale 1:250,000 or 1 inch to 3·9 stat. miles. Sheet 36–I. Jebel Assotriba, Egyptian Sudan. London: Geographical Section, General Staff, 1909. *Price* 1*s.* 6*d. each sheet. Presented by the Director of Military Operations.*

**Morocco.** **Langhans.**

Kampfplatz um Melilla mit den Bergwerken und Eisenbahnbauten der europäischen Minengesellschaften. Scale 1:200,000 or 1 inch to 3·2 stat. miles. Befestigungsraum von Melilla. Scale 1:50,000 or 1·3 inch to 1 stat. mile. Uebersicht der Rifküste zum Verfolg der spanischen Operationen gegen die Rifkabylen. Scale 1:1,500,000 or 1 inch to 23·6 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1909, Tafel 36. Gotha: Justus Perthes, 1909. *Presented by the Publisher.*

## AMERICA.

**Brazil.** **Moura.**

Mappa do Sul do Brazil organisado por Gentil de Assis Moura. Scale 1:2,500,000 or 1 inch to 39·5 stat. miles. 2 sheets. S. Paulo: Estabelecimento Graphico-Weiszflog Irmãos. Hamburg: L. Friederichsen & Co., [1909]. *Price* 20*m. Presented by Messrs. Friederichsen & Co., Hamburg.*

Most creditable survey work has in recent years been accomplished by the Geographical and Geological Commission of São Paulo, to which the author of this map is attached, and the results, now being published on the scale of 1:100,000, have been noticed in the *Geographical Journal* as the sheets have appeared. The present map embraces the whole of southern Brazil south of lat. 15°, and is reduced from the 1:100,000 sheets so far as they cover the area included; but for the other districts the material available in the compilation varies considerably in quality, and in many parts is nothing like so good as that for the state of São Paulo. However, notwithstanding the many blanks, and the rough nature of the material that exists, especially in the western part of the map, a considerable amount of fairly reliable survey work has been done in other districts, including railway, mining, and boundary surveys; and all these have been utilized by the author in the construction of this useful general map. Railways, relative importance of towns, colonies, heights, navigable rivers, and other information is clearly shown, and the map has been carefully drawn and printed in colours.

**Brazil—S. Paulo.** **Commissão Geographica e Geologica de S. Paulo.**

Topographical map of the State of Sao Paulo. Scale 1:100,000 or 1 inch to 1·6 stat. mile. Sheet: S. Bento. S. Paulo: Commissão Geographica e Geologica do Estado de S. Paulo, 1909. *Presented by the Geographical and Geological Commission of S. Paulo.*

**Brazil—S. Paulo.** **Krone.**

Die Sambaquis und die vorquartären Strandlinien im Mündungsgebiet des Ribeira-Flusses (Staat São Paulo). Entworfen von R. Krone. Scale 1:400,000 or 1 inch to 6·3 stat. miles. *Petermanns Mitteilungen*, Jahrgang 1909, Tafel 28. Gotha: Justus Perthes 1909. *Presented by the Publisher.*

Canada. Department of the Interior, Ottawa.

Map of Alberta. Scale 1 : 792,000 or 1 inch to 12·5 stat. miles. 2 sheets. Map of Southern Saskatchewan. Scale 1 : 792,000 or 1 inch to 12·5 stat. miles. Ottawa : Department of the Interior, 1909. *Presented by the High Commissioner in London for the Dominion of Canada.*

## AUSTRALASIA.

Queensland. Geological Survey, Brisbane.

Sketch-map of the Herberton and Chillagoe Gold and Mineral Fields. Compiled from official and other sources under the supervision of W. H. Greenfield. Scale 1 : 380,160 or 1 inch to 6 stat. miles. Brisbane : Geological Survey Office, Department of Mines, 1909. *Price* 1*s.* 6*d. Presented by the Geological Survey of Queensland.*

The Herberton and Chillagoe Gold and Mineral Fields are situated to the south-west of Cairns on the coast of Queensland. The map shows mineral leases, which are numbered in red, railways, roads, telegraphs, and other information likely to be useful to those interested in the district. An index to gold and mineral leases is given as an inset.

## POLAR REGIONS.

Arctic Regions. Langhans.

Die Erreichung des Nordpols. Scale 1 : 20,000,000 or 1 inch to 316·6 stat. miles. *Petermanns Mitteilungen,* Jahrgang 1909, Tafel 34. Gotha : Justus Perthes, 1909. *Presented by the Publisher.*

## GENERAL.

World. Bartholomew.

Handy Reference Atlas of the World. Edited by J. G. Bartholomew, F.R.S.E., F.R.G.S. 8th edition. With general index and geographical statistics. London : John Walker & Co., Ltd., 1909. *Price* 7*s.* 6*d. net. Presented by the Publisher.*

In the present edition of this useful little atlas, several new plates have been added, while others have been revised to bring them up to date. In some instances, however, further revision is necessary, especially in the Polar maps. The statistics have been corrected according to the most recent census returns.

World. Eckert.

Isochronen-Karte der Erde in mittabstandstreuer Projektion mit dem Mittelpunkt Berlin. Entworfen und gezeichnet von Max Eckert. Central meridian scale 1 : 64,000,000 or 1 inch to 1010 stat. miles. *Petermanns Mitteilungen,* Jahrgang 1909, Tafel 25. Gotha : Justus Perthes, 1909. *Presented by the Publisher.*

This map shows, on an equidistant projection, with Berlin as the centre, the number of days it takes at the present time to travel from that city to all parts of the world. This is accomplished by colour tints, all regions having the same tint, being the same distance away. The intervals are : 1, 2, 3–5, 6–10, 11–15, 16–20, 21–25, 26–30, 31–40, and over 40 days.

It is interesting to compare this map with that for a similar purpose prepared by Sir Francis Galton, F.R.S., twenty-eight years ago, and published in the *Proceedings of the R.G.S.* in November, 1881. This showed distances from London in intervals of ten days, and was compiled by the author with the greatest care and from the best available sources at the time. The acceleration and increased rapidity of communication is clearly indicated in many instances, perhaps the most striking being the opening up of Central Asia by the Siberian railway. The present map is on a larger scale, and a more suitable projection for the purpose, than Sir Francis Galton's, which was on Mercator's projection. Prof. Eckert's map is accompanied by full explanation in *Petermanns Mitteilungen* for September last.

World. Philip.

Philips' comparative series of Large School Maps. The World in Mercator's Projection showing the British Empire, other Colonial Powers and Commercial Highways. Equatorial scale 1 : 24,000,000 or 1 inch to 378·7 stat. miles. London : George Philip & Son., Ltd., [1909]. *Price* 14*s., mounted on rollers and varnished. Presented by the Publisher.*

A general wall-map of the world on Mercator's projection, intended for use of schools.

British possessions are clearly distinguished in red, and the main railways, ocean lines, and cables laid down. There is no attempt at representing mountains or hills. The map measures 68 inches by 54 inches, and is mounted on rollers.

**World.** **Philip.**

Philips' New School Atlas of Comparative Geography. A series of seventy-two coloured physical, political, and commercial maps and diagrams, with a consulting index. London: George Philip & Son, Ltd., [1909]. *Price* 2*s.* 6*d.* *Presented by the Publishers.*

One of the many cheap school atlases that are now being published to meet the increasing demand for geographical works for teaching purposes on approved lines. In addition to the ordinary general political maps, physical maps showing relief by colour-tinting are also given. It would be unreasonable to expect too much from an atlas only costing half a crown, but without any extra expense, some of the maps might have been clearer, and if less colour had been used it would have tended to this end. However, they vary considerably in character, and some of the little physical maps at the commencement are quite good.

## CHARTS.

**Atlantic, North.** **U.S. Hydrographic Office.**

Pilot chart of the North Atlantic ocean, September, 1909. Washington: U.S. Hydrographic Office, 1909. *Presented by the U.S. Hydrographic Office.*

**Atlantic, North.** **U.S. Weather Bureau.**

Meteorological chart of the North Atlantic Ocean, October and November, 1909. Washington: Department of Agriculture, U.S. Weather Bureau, 1909. *Presented by the U.S. Weather Bureau.*

**Atlantic, North, and Mediterranean.** **Meteorological Office.**

Monthly meteorological charts of the North Atlantic and Mediterranean, October, 1909. London: Meteorological Office, 1909. *Price* 6*d. each. Presented by the Meteorological Office.*

**Denmark.** **Kgl. Danske Søkort Arkiv.**

Kort udgivet af det Kongelige Danske Sökort-Arkiv. Nos. 227, Kattigat sydvestlige Del (Samsö-Bælt; 228, Grönsund; 230, Graadyb). Copenhagen: Kongelige Danske Sökort-Arkiv, 1909. *Presented by the Danish Admiralty.*

**Indian Ocean and Red Sea.** **Meteorological Office.**

Monthly meteorological charts of the Indian Ocean north of 15° S. lat. and Red Sea, October, 1909. London: Meteorological Office, 1909. *Price* 6*d. each. Presented by the Meteorological Office.*

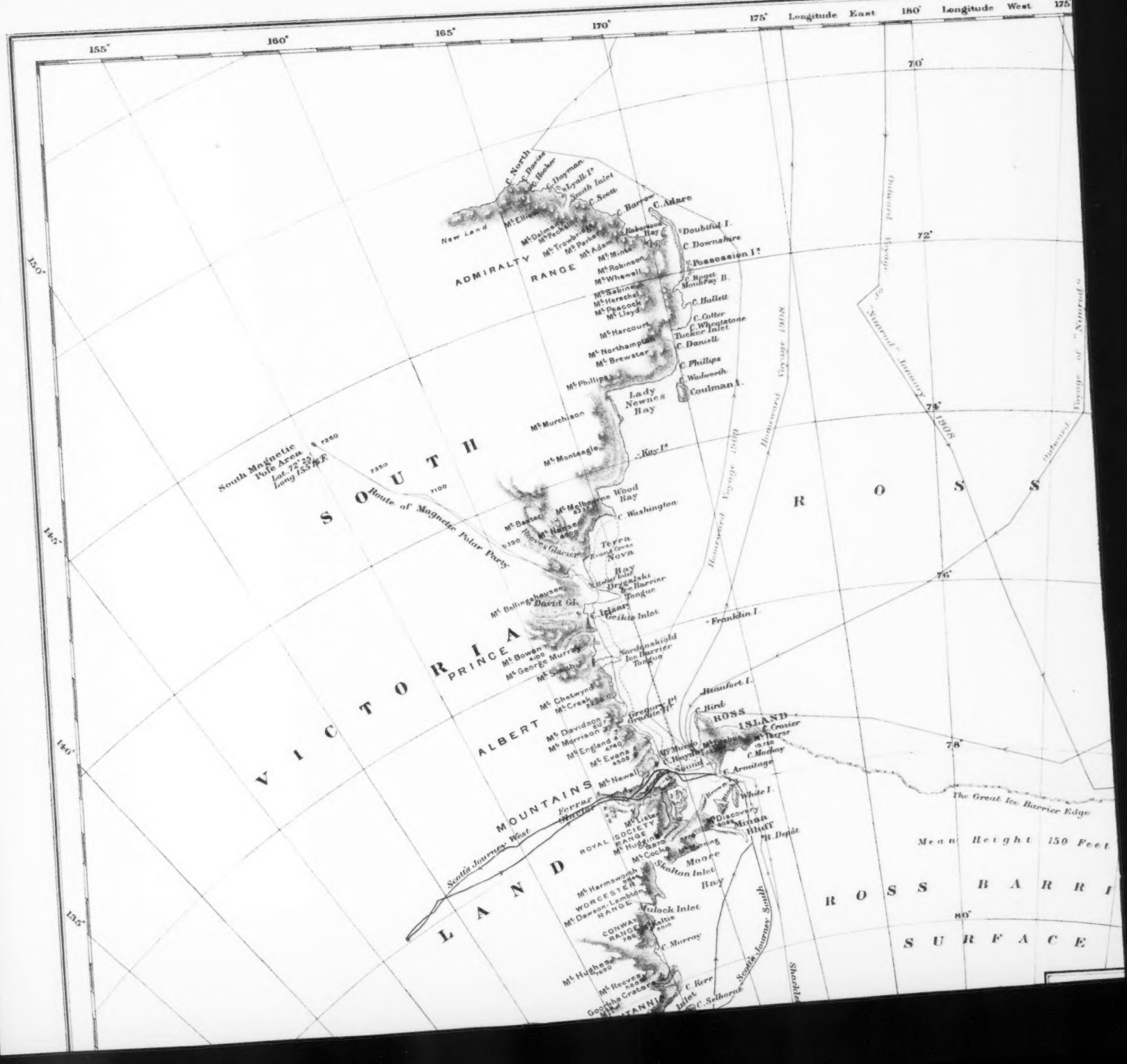
**Pacific, North.** **U.S. Hydrographic Office.**

Pilot chart of the North Pacific Ocean, October, 1909. Washington: U.S. Hydrographic Office, 1909. *Presented by the U.S. Hydrographic Office.*

**Pacific, North.** **U.S. Weather Bureau.**

Meteorological chart of the North Pacific Ocean, October and November, 1909. Washington: Department of Agriculture, U.S. Weather Bureau, 1909. *Presented by the U.S. Weather Bureau.*

**N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.**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135°
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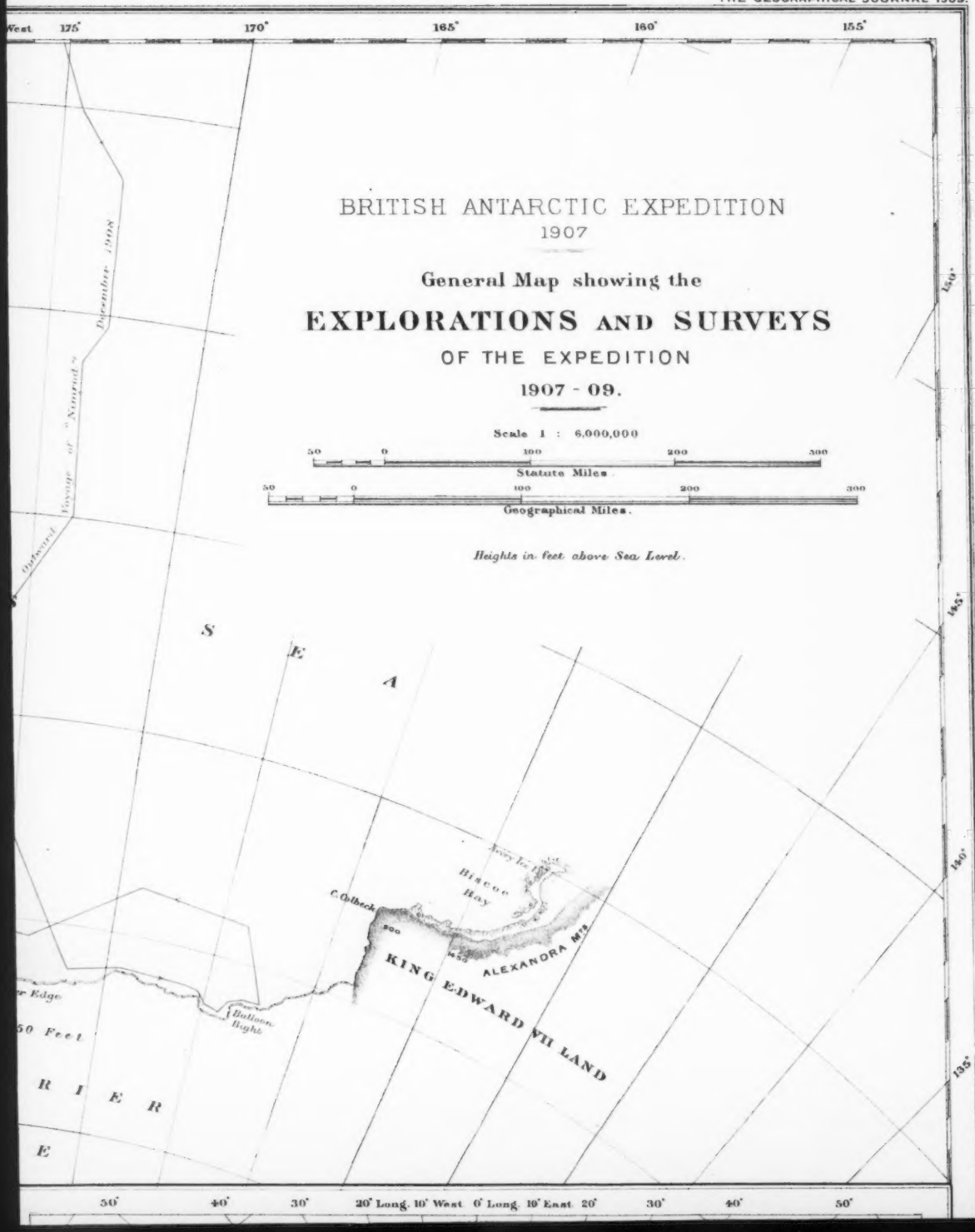
C. North
C. Dacres
C. Hooker
C. Dayman
C. Lyall I.
South Inlet
C. Scott
C. Barrow
C. Adare
Doubtful I.
C. Downshire
Possession I.
C. Regent
Monkey B.
C. Hallett
C. Cotter
C. Wheatstone
Tucker Inlet
C. Daniell
C. Phillips
C. Wadworth
Coulman I.
Lady Newnes Bay
Mt. Murchison
Mt. Montagle
Kay I.
Mt. Melbourne
Wood Bay
C. Washington
Terra Nova Bay
Drygalski Ice Barrier Tongue
Mt. Bellingshausen
David Gl.
Isles
Orthia Inlet
Franklin I.
Mt. Bowen
Mt. George Murray
Mt. Smith
Sverdrup Ice Barrier Tongue
Mt. Chetwynd
Mt. Creak
Mt. Davidson
Mt. Morrison
Mt. England
Mt. Evans
Gregory Pt.
Beaufort I.
C. Bird
ROSS ISLAND
C. Crozier
Mt. Terror
C. Madeay
C. Armitage
Mt. Haswell
Terror
Erebus
White I.
Mt. Lister
ROYAL SOCIETY RANGE
Mt. Hughes
Mt. Cocks
Mt. Harding
Discovery Hut
Mt. Depot
Mt. Harmsworth
WORCESTER RANGE
Mt. Dawson-Lambton
Shalton Inlet
Moore Bay
Mulock Inlet
CONWAY RANGE
Mt. Keltie
C. Murray
Mt. Hughes
Mt. Reeves
Goodha Craters
C. Kerr
Inlet
C. Selborne
Shackleton Inlet
ADMIRALTY RANGE
Mt. Dalmer
Mt. Packham
Mt. Troubridge
Mt. Parker
Mt. Adam
Mt. Minto
Mt. Robinson
Mt. Whewell
Mt. Sabine
Mt. Herschel
Mt. Peacock
Mt. Lloyd
Mt. Harcourt
Mt. Northampton
Mt. Brewster
Mt. Phillips
Bakewell Bay
South Magnetic Pole Area
Lat. 72° 25'
Long 155° E
7250
7100
5750
4000
Route of Magnetic Polar Party
Nares Glacier
Ferrar Glacier
Scott's Journey West
Scott's Journey South
Homeward Voyage 1900
Outward Voyage
Nansen's Journey 1908
Outward Voyage of "Nimrod"
The Great Ice Barrier Edge
Mean Height 150 Feet
VICTORIA LAND
PRINCE ALBERT MOUNTAINS
ROSS BARRIER SURFACE


West
175°
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BRITISH ANTARCTIC EXPEDITION
1907
General Map showing the
EXPLORATIONS AND SURVEYS
OF THE EXPEDITION
1907 - 09.
Scale 1 : 6,000,000
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Statute Miles
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Geographical Miles.
Heights in feet above Sea Level.
Outward Voyage of "Nimrod"
December 1908
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ALEXANDRA Mts
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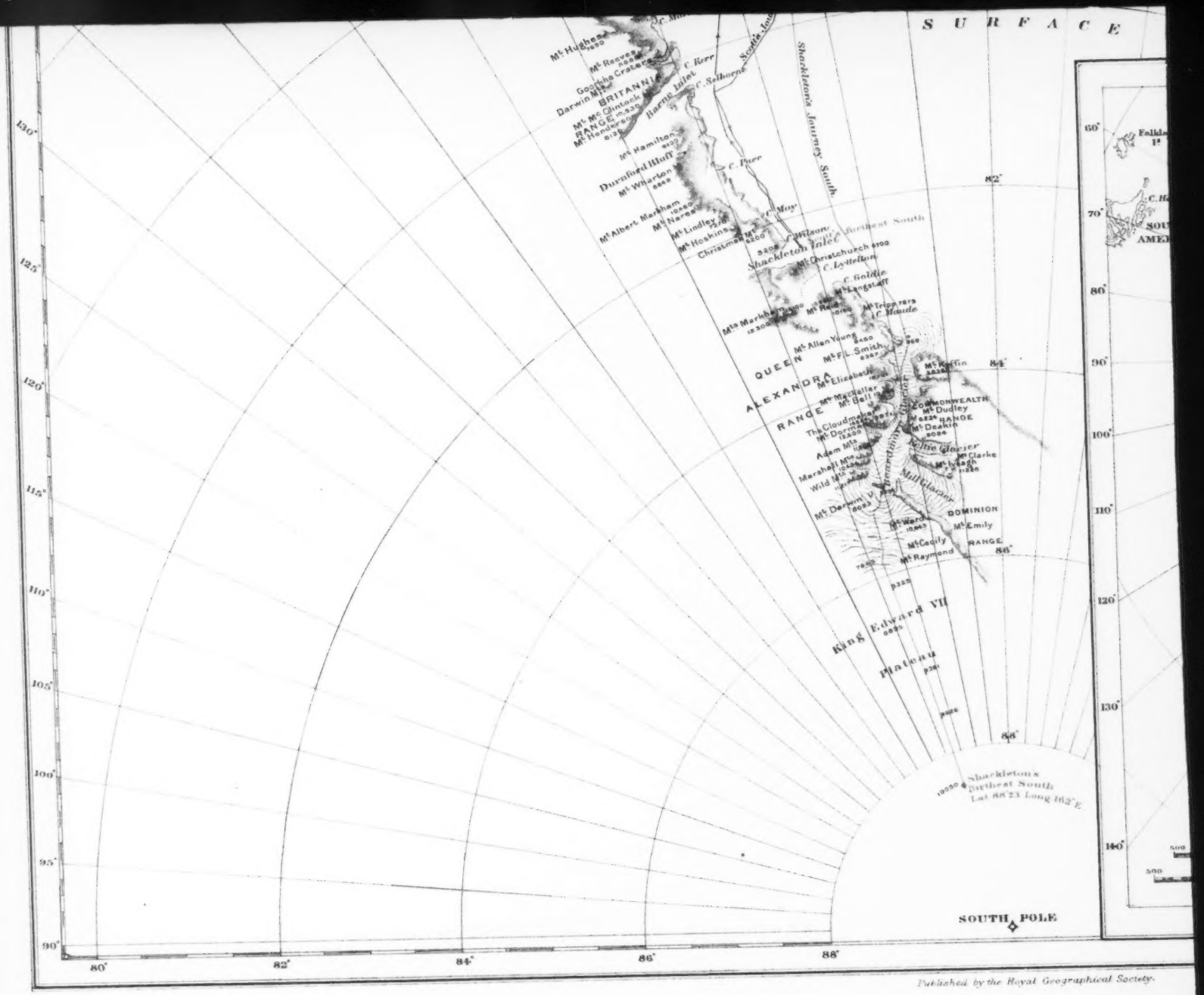
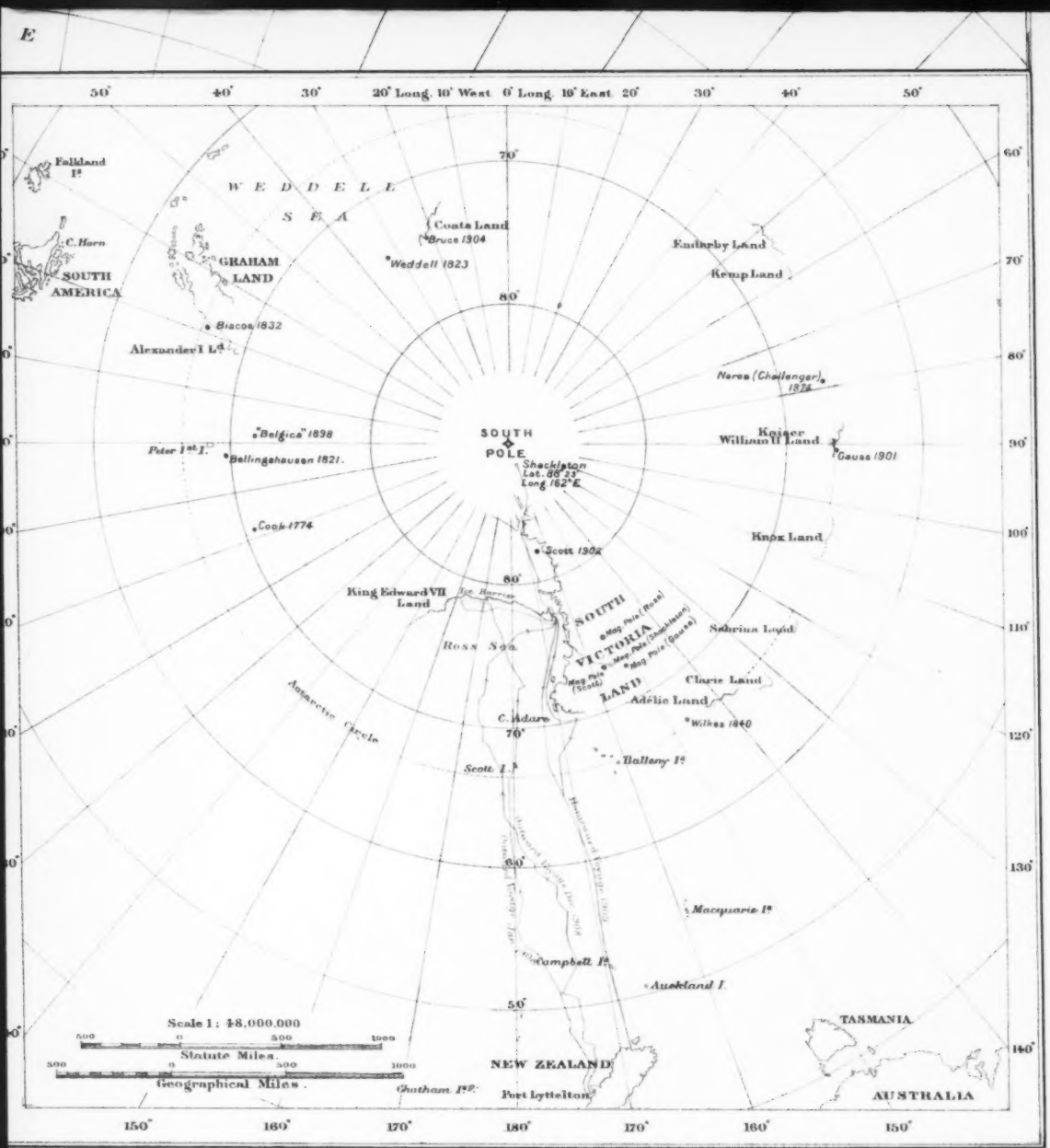



Published by the Royal Geographical Society.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SOUTH AMERICA
GRAHAM LAND
Coats Land
Bruce 1904
Weddell 1823
Enderby Land
Kemp Land
Biscoe 1832
Alexander I L.d
Nares (Challenger) 1874
"Belgica" 1898
Peter 1st I.
Bellingshausen 1821.
SOUTH POLE
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Kaiser William II Land
Gauss 1901
Cook 1774
Scott 1902
Knox Land
King Edward VII Land
Mag. Pole (Ross)
Mag. Pole (Shackleton)
Mag. Pole (Gauss)
Mag. Pole (Scott)
SOUTH VICTORIA LAND
Ross Sea
Sabrina Land
Clarie Land
Adélie Land
Antarctic Circle
C. Adare
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Ballany Is
Scott I.
Macquarie Is
Campbell Is
Auckland I.
Scale 1 : 48,000,000
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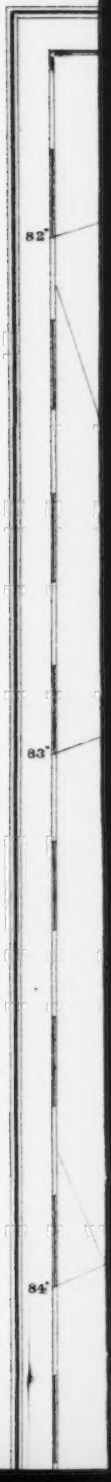
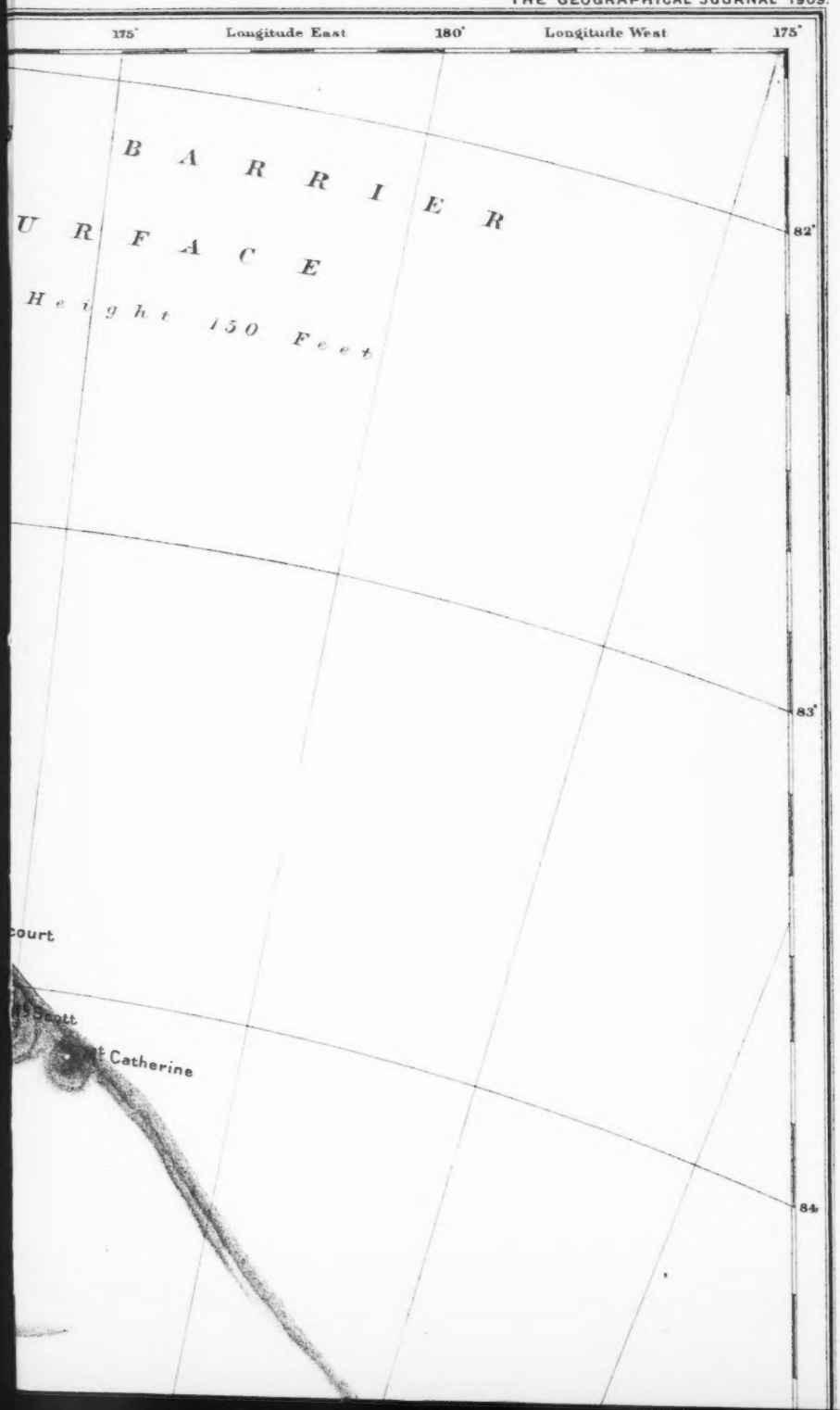
TASMANIA
AUSTRALIA

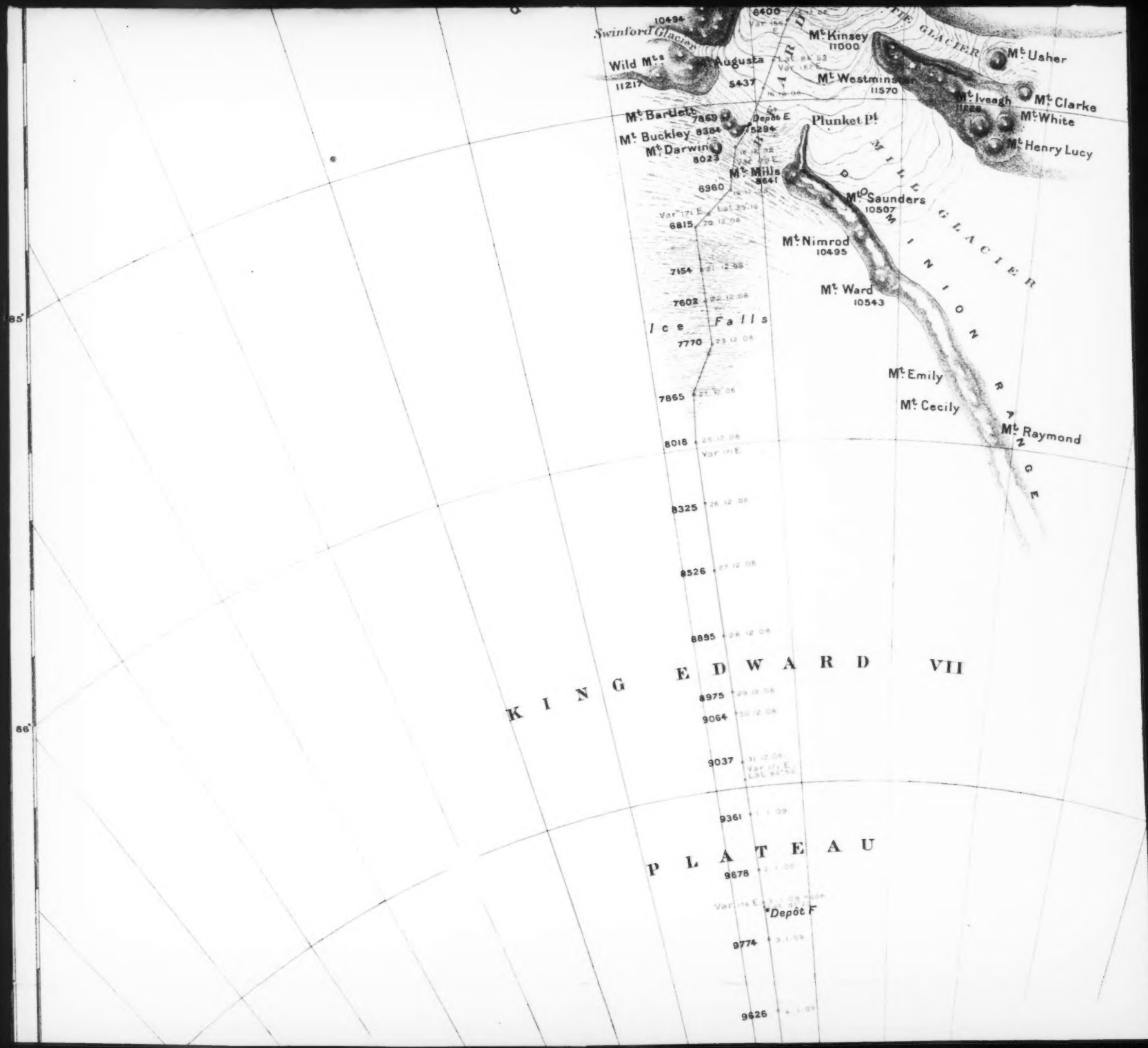
Society.

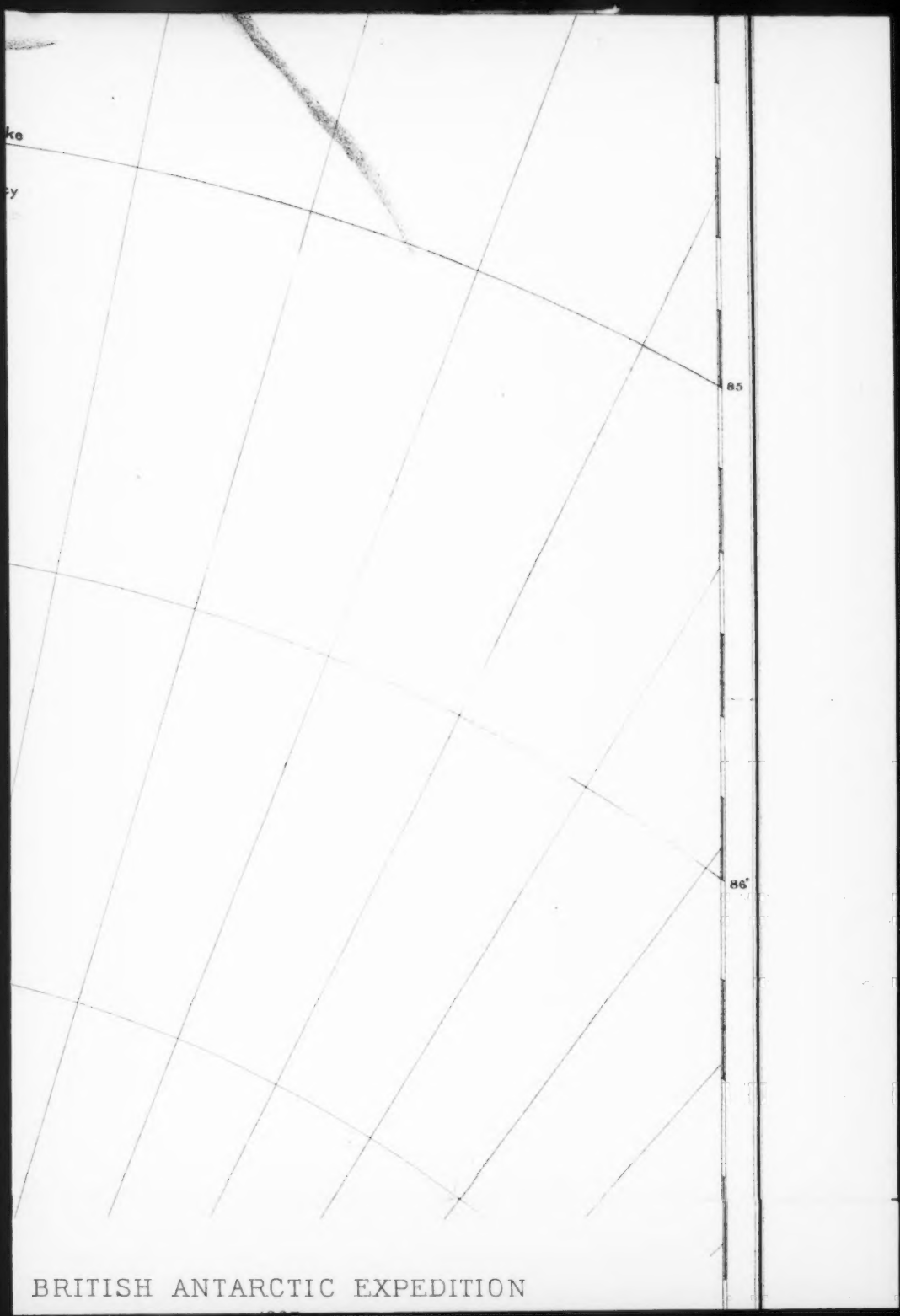

82°
83°
84°

155°
160°
165°
170°
82°
83°
84°
R O S S
S U
M e a n H e
6200
Mt. Christmas
C. Wilson
Capt. R. F. Scott's farthest south
9208
Shackleton Inlet
Mt. Christchurch
4700
C. Lyttelton
Crisi Depot (C)
C. Goldie
Mt. Cara
Mt. Lysaght
12300
Longstaff Mts.
10350
Mt. Reid
10160
Markham Mts.
Mt. Bonaparte
Mt. Lecointe
Mt. Rabot
Mt. Tripp
7878
Mt. Lloyd
9010
Mt. Millen
11570
Quan Depot
C. Maude
Mt. Asquith
Mt. Allen Young
9450
Mt. F. L. Smith
6387
Mt. Fox
Mt. Ida
Depot D.
Socks Glacier
1154
Mt. Anne
10271
1003
Mt. Elizabeth
10761
Alice Glacier
Mt. Hope
2758
Mt. Harcourt
Mt. Kyffin
5836
1408
Mt. Henry
Mt. Scott
Mackellar
Bell
Mt. Stanley
Mt. Lockwood
Mt. Cyril
Hood Glacier
The Cloudmaker
Mt. Kirkpatrick
9971
14824
2683
Mt. Patrick
7580
Mt. Dudley
Mt. Donaldson
3042
Mt. Dorman
13500
Bingley Glacier
3644
6750
Mt. Deakin
9094
Adams Mts.
11809
Berwick Glacier
4838
Marshall Mts.
10494
6400
Swinford Glacier
Mt. Kinsey
11000
Mt. Usher
Wild Mts.
Mt. Augusta
5437
Mt. Westminster
QUEEN ALEXANDRA RANGE
VICTORIA LAND
COMMONWEALTH
KELTIE GLACIER


175° Longitude East
180°
Longitude West 175°
B A R R I E R
U R F A C E
H e i g h t 150 F e e t
82°
83°
84°
court
Scott
t Catherine

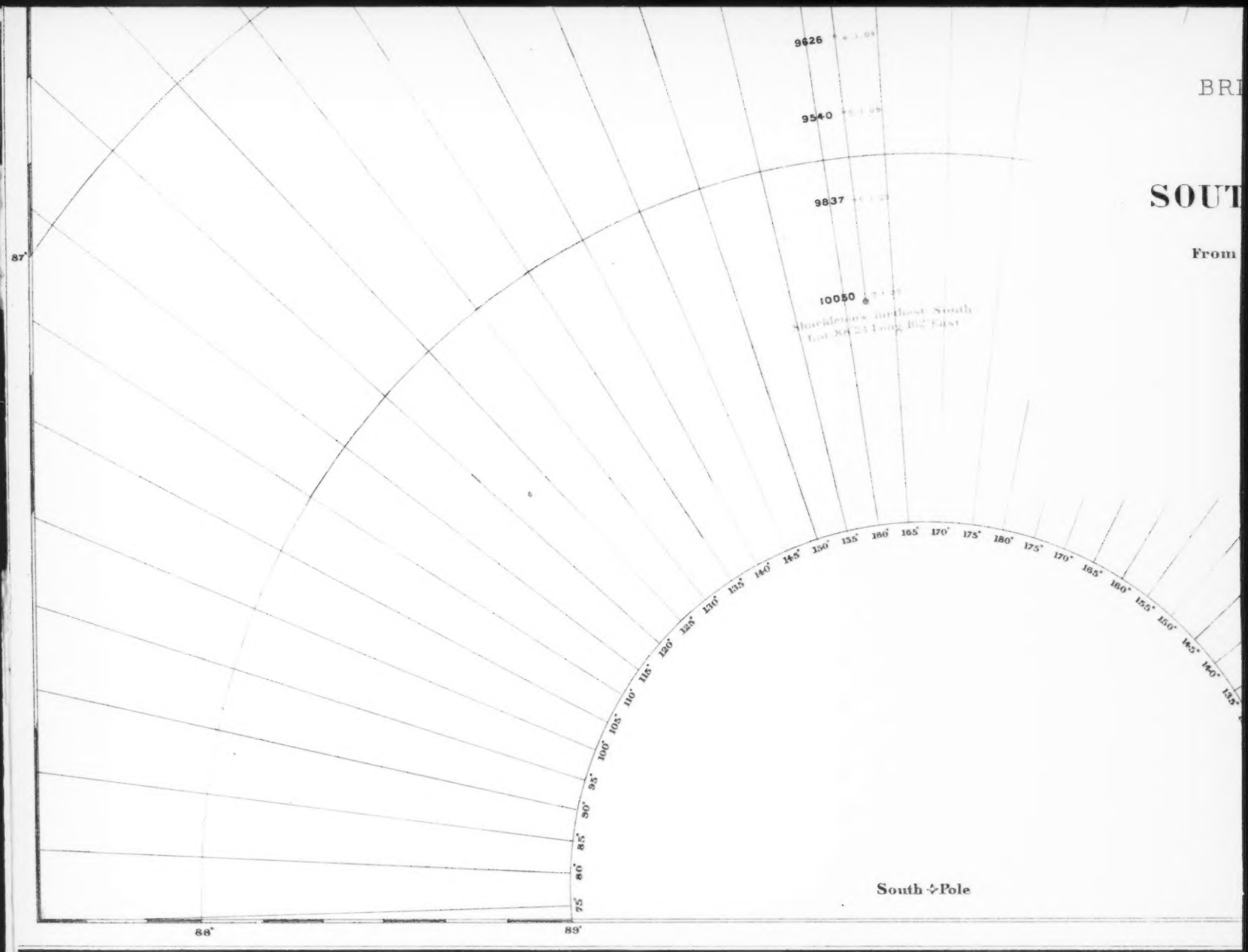
85°
86°


Swinford Glacier
10494
6400
Wild Mts
Mt. Augusta
11217
5437
Mt. Kinsey
11000
Mt. Westminster
11570
Mt. Usher
Mt. Iveagh
11228
Mt. Clarke
Mt. White
Mt. Henry Lucy
Mt. Bartlett
7869
Depôt E
5284
Mt. Buckley
8384
Mt. Darwin
8023
Mt. Mills
8641
Plunket Pt
6960
6815
Mt. Saunders
10507
Mt. Nimrod
10495
7154
7602
Mt. Ward
10543
Ice Falls
7770
Mt. Emily
7865
Mt. Cecily
Mt. Raymond
8018
8325
8526
8895
8975
9064
9037
9361
9678
*Depôt F
9774
9626
85°
86°
KING EDWARD VII
PLATEAU




BRITISH ANTARCTIC EXPEDITION

87°


BRI
SOUT
From
9626
9540
9837
10050
Shackleton's furthest South
Lat 88° 23' Long 162° East
87°
88°
89°
South Pole
Published by the Royal Geographical Society

BRITISH ANTARCTIC EXPEDITION

1907

Route and Surveys
of the

# OUTHERN JOURNEY PARTY

1908-09.

From Traverses and Astronomical Observations
by

ERIC MARSHALL, M.R.C.S., L.R.C.P.

Cartographer.

Scale 1:1,500,000

10 5 0 10 20 30 40

Statute Miles

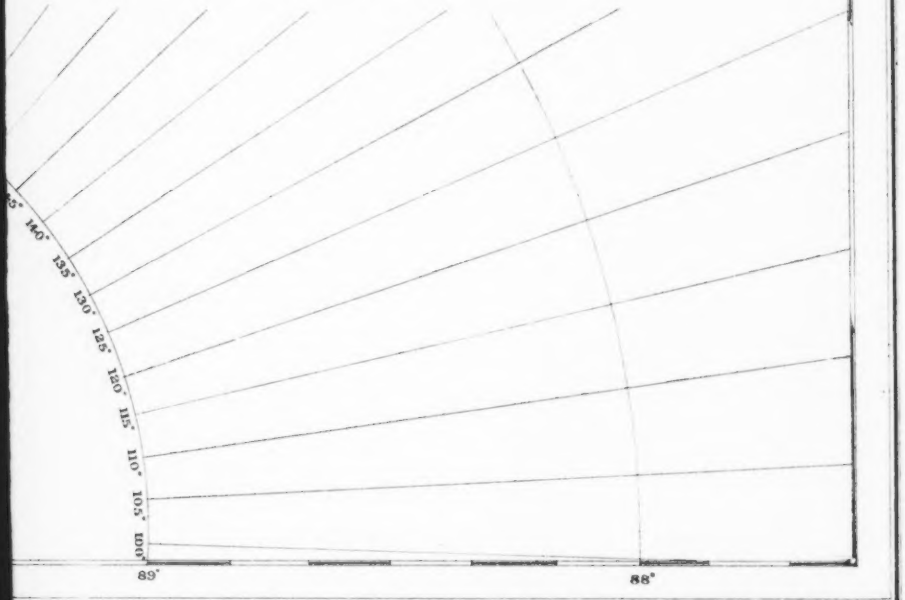
10 5 0 10 20 30 40

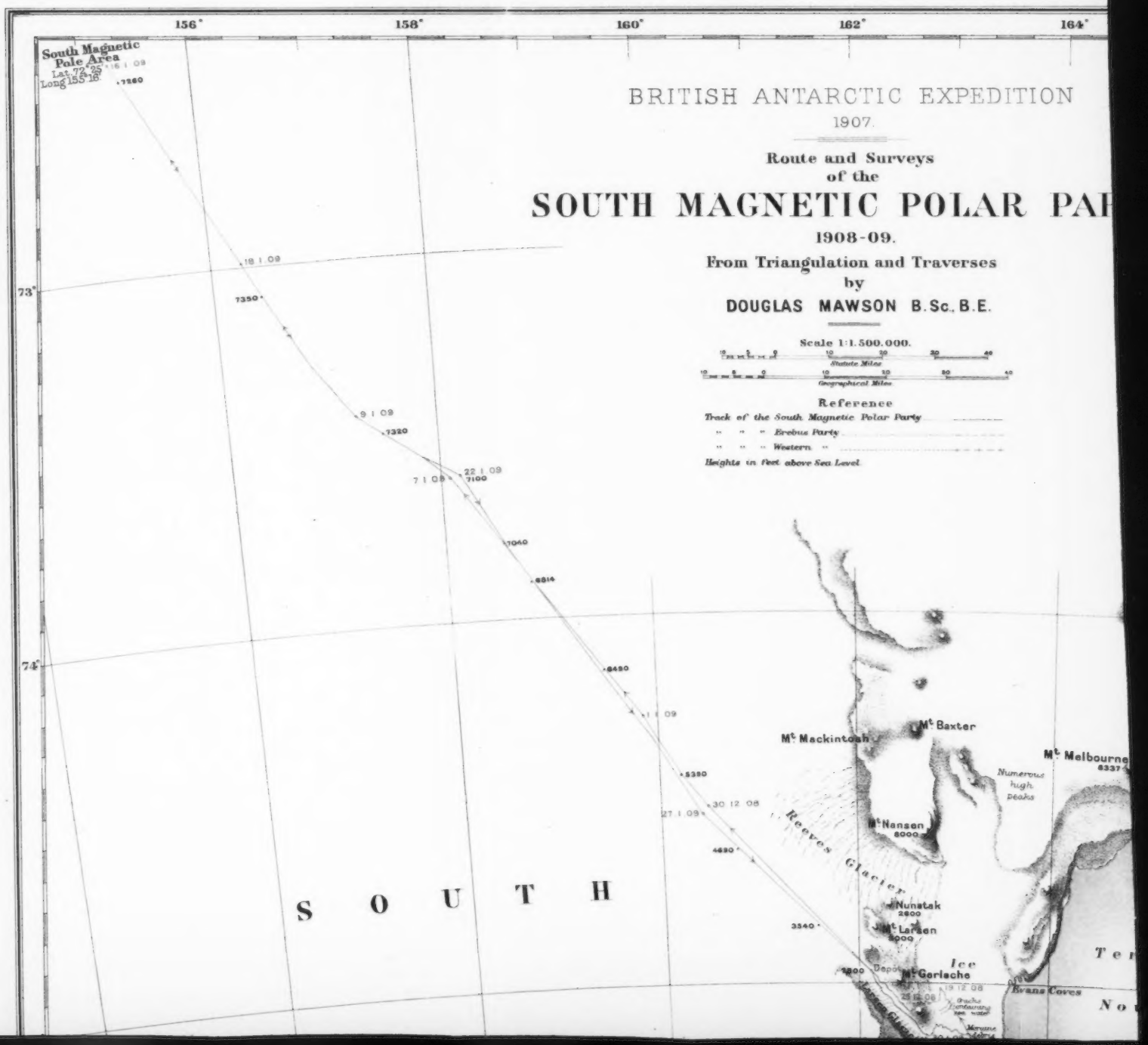
Geographical Miles

*Heights in feet above sea level.*

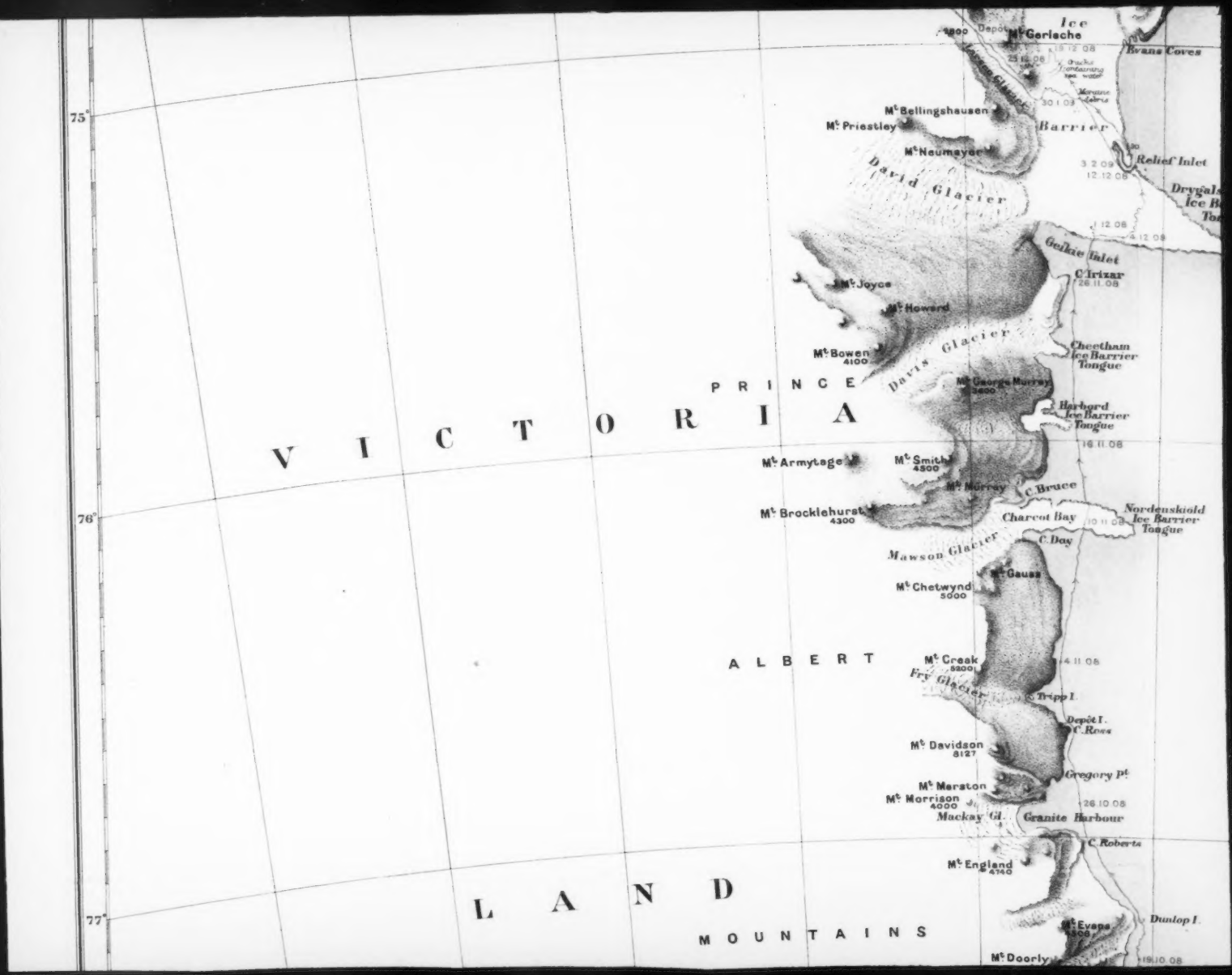
*Outward track of Southern journey* ———

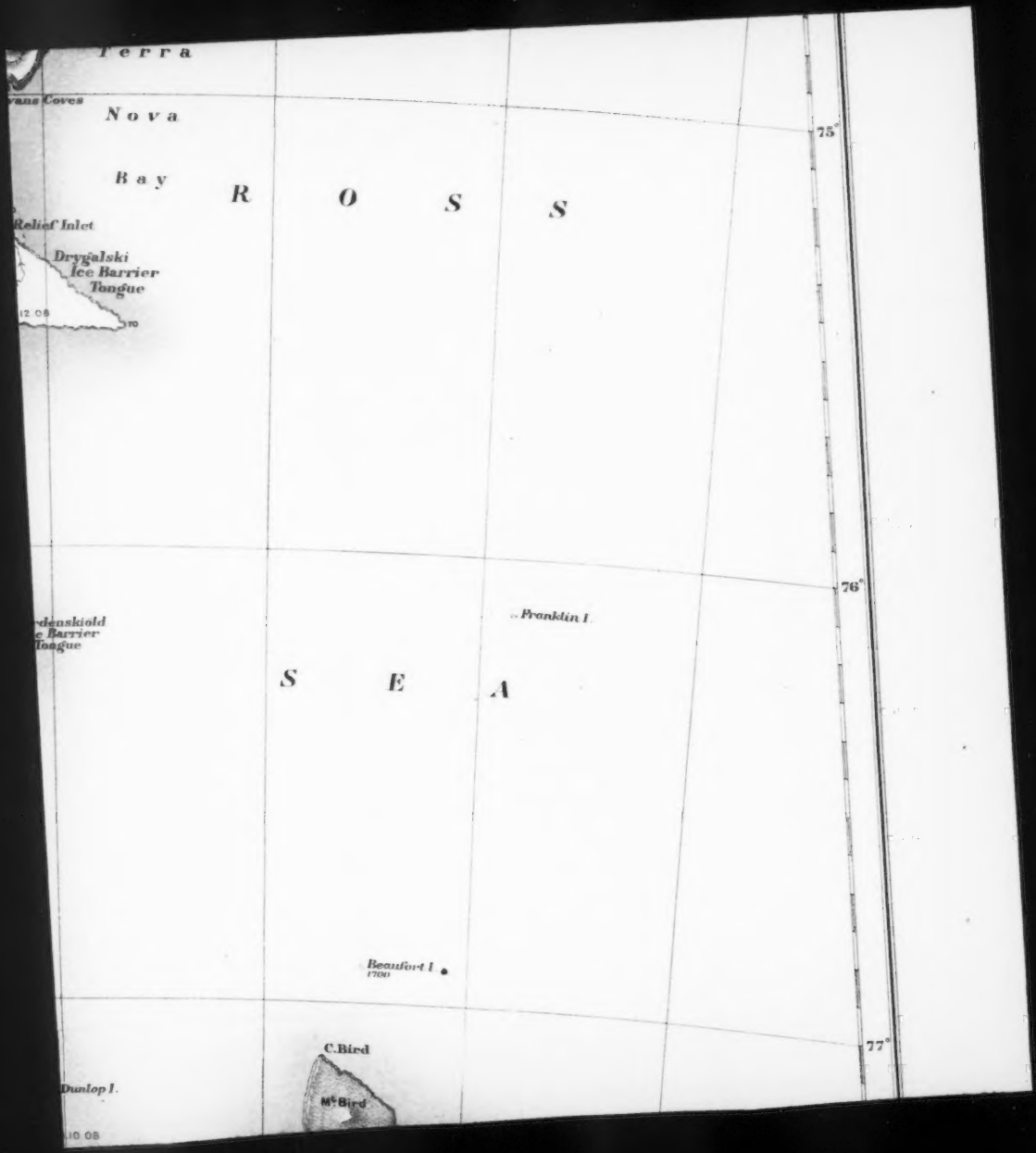
*On the return journey Mr. Shackleton's party followed the same track, with very slight variations.*

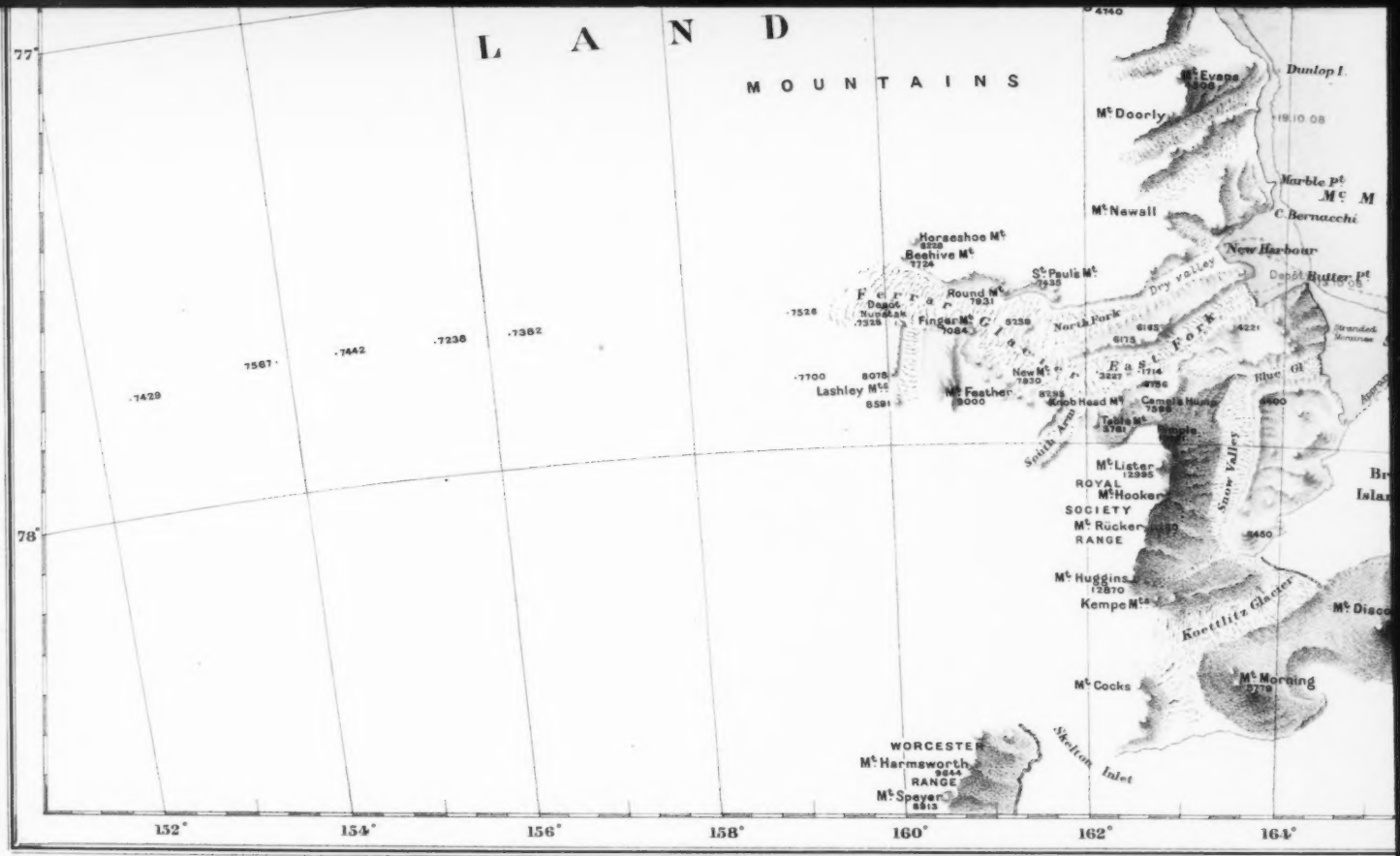



156°
158°
160°
162°
164°
73°
74°
South Magnetic Pole Area
Lat. 72° 25'
Long. 155° 16'
BRITISH ANTARCTIC EXPEDITION
1907.
Route and Surveys
of the
SOUTH MAGNETIC POLAR PAR
1908-09.
From Triangulation and Traverses
by
DOUGLAS MAWSON B.Sc. B.E.
Scale 1:1.500.000.
Statute Miles
Geographical Miles
Reference
Track of the South Magnetic Polar Party
" " " Erebus Party
" " " Western "
Heights in Feet above Sea Level.
18 1 09
7350
9 1 09
7320
7 1 09
22 1 09
7100
7040
6814
6420
1 1 09
5380
30 12 08
27 1 09
4430
3540
2800
19 12 08
25 12 08
S O U T H
Mt. Mackintosh
Mt. Baxter
Mt. Melbourne
6337
Numerous high peaks
Mt. Nansen
8000
Reeves Glacier
Nunatak
2800
Mt. Larsen
8000
Mt. Gerlache
Ice
Depot
Evans Coves
Ter
No

164°
166° E. Longitude
168°
ITION
R PARTY
Mt. Brewster
73°
Mt. Phillips
Mt. Lubbock
Lady Newnes
Bay
Mt. Murchison
Coulman I.
Mt. Monteagle
Kay Is
74°
C. Sibbald
Wood
Bay
Mt. Melbourne
8337
C. Washington
Terra
Nova


Ice
Depot
Mt Gerlache
Evans Coves
Mt Bellingshausen
Mt Priestley
Barrier
Mt Neumayer
Relief Inlet
David Glacier
Gelkie Inlet
C Irizar
Mt Joyce
Mt Howard
Mt Bowen
4100
Davis Glacier
Cheetham Ice Barrier Tongue
PRINCE
Mt George Murray
VICTORIA
Barbard Ice Barrier Tongue
Mt Armytage
Mt Smith
4300
Mt Murray
C Bruce
Mt Brocklehurst
4300
Charcot Bay
Nordenskiold Ice Barrier Tongue
C Day
Mawson Glacier
Mt Gauss
Mt Chetwynd
5000
ALBERT
Mt Creak
Fry Glacier
Tripp I.
Depot I.
C Ross
Mt Davidson
8127
Gregory Pt
Mt Merston
Mt Morrison
4000
Mackay Gl.
Granite Harbour
C Roberts
Mt England
4140
LAND
MOUNTAINS
Mt Evans
Dunlop I.
Mt Doorly
75°
76°
77°


Terra
Nova
Bay
ROSS
SEA
Relief Inlet
Drygalski
Ice Barrier
Tongue
Franklin I.
Beaufort I
1700
C.Bird
Mt Bird
Dunlop I.
75°
76°
77°

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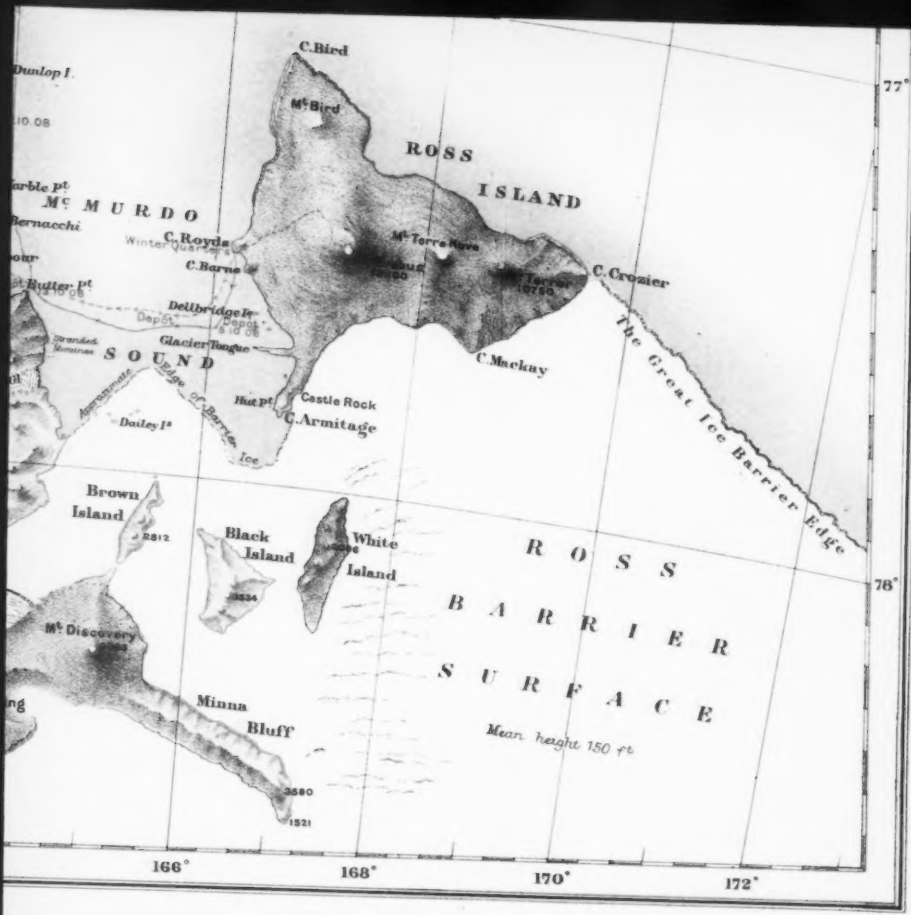
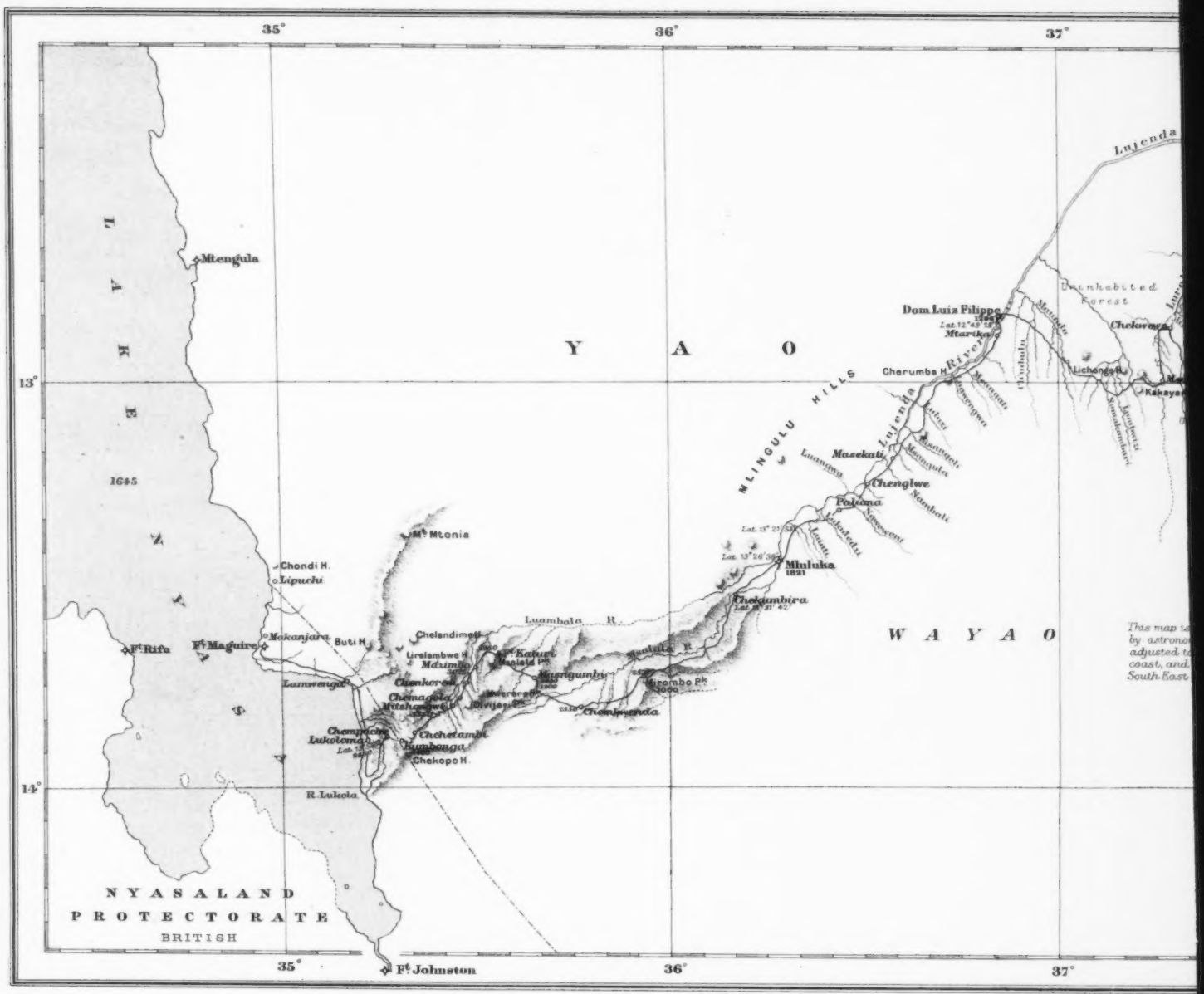
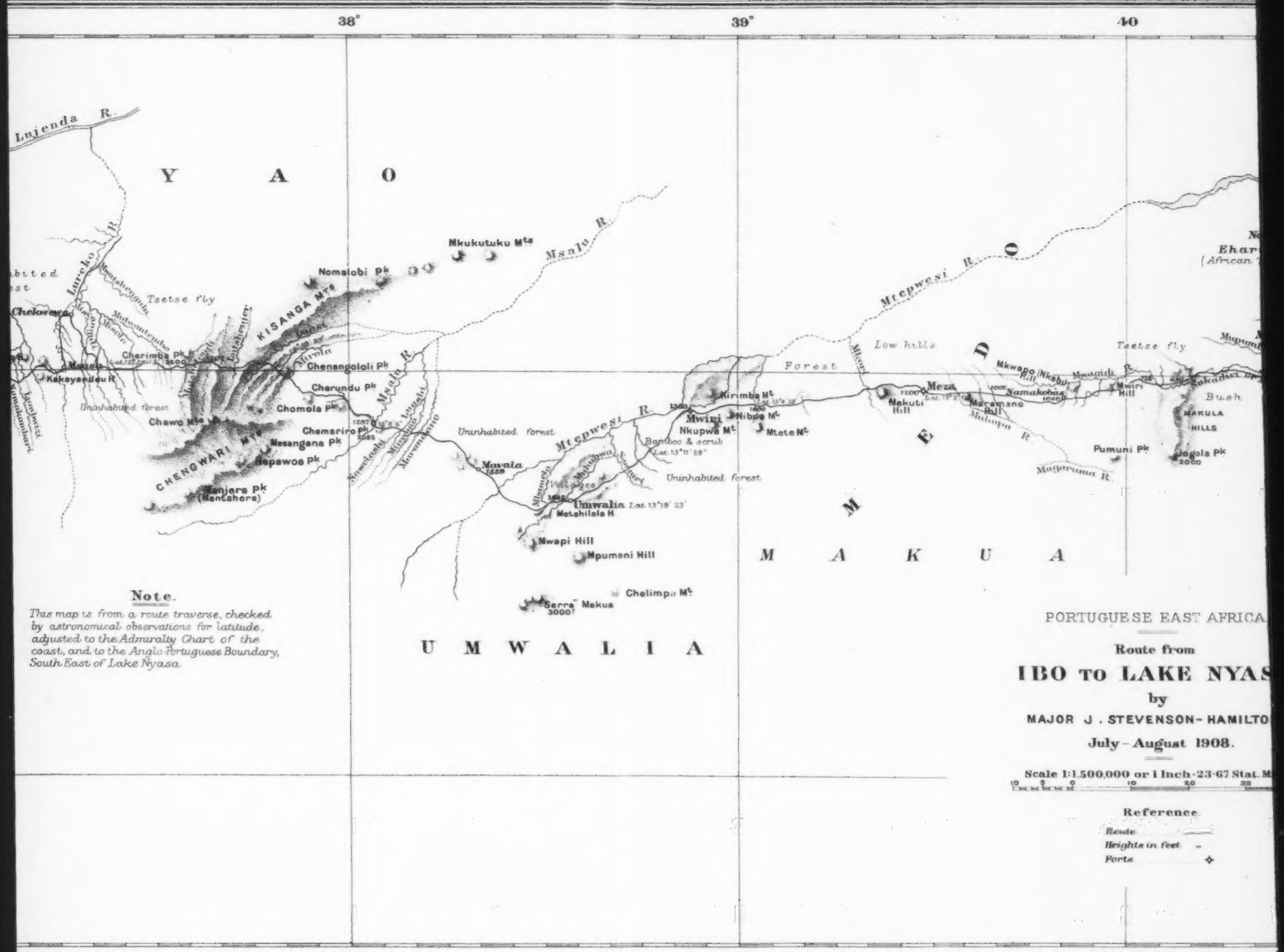
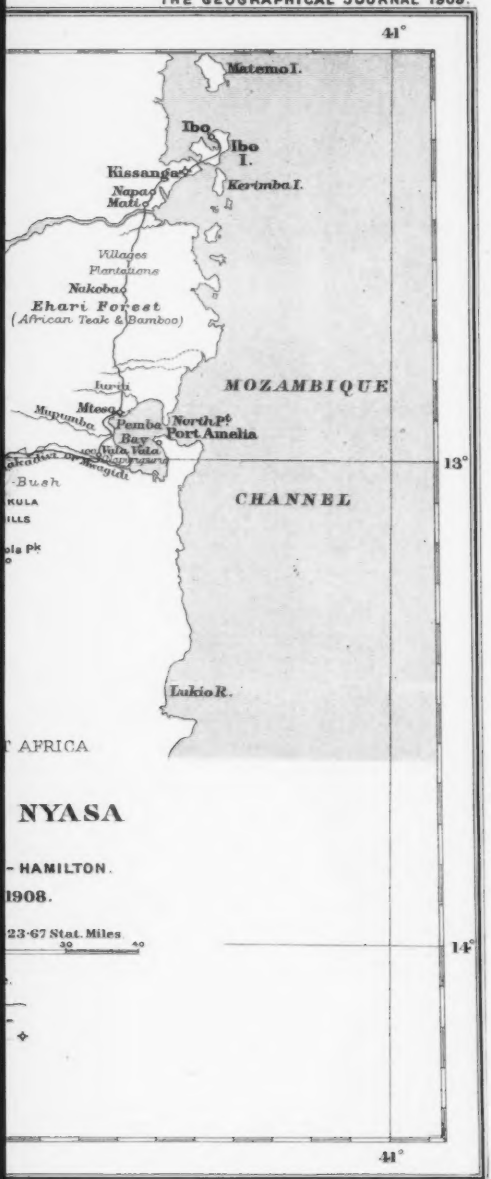

C.Bird
Dunlop I.
Mt Bird
ROSS
ISLAND
Mc MURDO
SOUND
C.Royds
Winter Quarters
C.Barne
Mt Terror
12400
Mt Bird
12350
C.Crozier
Butter Pt
Dellbridge Is
Depot
Glacier Tongue
C.Mackay
The Great Ice Barrier Edge
Hut Pt
Castle Rock
C.Armitage
Dailey Is
Ice
Brown
Island
2812
Black
Island
White
Island
ROSS
BARRIER
SURFACE
Mean height 150 ft
Mt Discovery
Minna
Bluff
3580
1521
77°
76°
166°
168°
170°
172°


35°
36°
37°
13°
14°
Mtengula
Y A O
Dom Luiz Filippe
Mtarika
Uninhabited Forest
Chekowera
Cherumba H.
Rivers
Lichonga R.
Kakaya
MLINGULU HILLS
Lujenda
Masekati
Chenglwe
Polana
Nambati
Mluluka
1821
Chekambira
Lat. 13° 21' 42"
Mt. Mtonia
Chondi H.
Lipuchi
Mokanjara
Buti H.
Ft. Rifta
Ft. Maguire
Chelandimeti
Luambala R.
Katuri
Mtangumbi
Chenkoreo
Chemacola
Mtshangwe H.
Chemalenda
Chemplecha
Lukoloma
Chekelambi
Chumbonga
Chekopo H.
R. Lukola
Lamwenga
Mirombo Pk.
NYASALAND
PROTECTORATE
BRITISH
Ft. Johnston
W A Y A O
This map
by astron
adjusted
coast, and
South East




Published by the Royal Geographical Society.

**PORTUGUESE EAST AFRICA.**
**Stevenson-Hamilton.**